SECTION 4 TEST RULE SUPPORT
FOR
21 HAZARDOUS AIR POLLUTANTS

Revised
DRAFT

Non-CBI Version

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I. OVERVIEW

The U.S. Environmental Protection Agency's Office of Pollution Prevention and Toxics (OPPT) is issuing a proposed test rule under Section 4 of the Toxic Substances Control Act (TSCA). This proposed test rule shall require a variety of health effects testing on the following 21 hazardous air pollutants:

CHEMICAL NAME	CAS NUMBER	CHEMICAL NAME	CAS NUMBER
Biphenyl	92-52-4	Hydrogen Fluoride	7664-39-3
Carbonyl Sulfide	463-58-1	Maleic Anhydride	108-31-6
Chlorine	7782-50-5	Methyl Isobutyl Ketone	108-10-1
Chlorobenzene	108-90-7	Methyl Methacrylate	80-62-6
Chloroprene	126-99-8	Naphthalene	91-20-3
Cresols (mixed)	1319-77-3	Phenol	108-95-2
Diethanolamine	111-42-2	Phthalic Anhydride	85-44-9
Ethyl Benzene	100-41-4	1,2,4-Trichlorobenzene	120-82-1
Ethylene Dichloride	107-06-2	1,1,2-Trichloroethane	79-00-5
Ethylene Glycol	107-21-1	Vinylidene Chloride	75-35-4
Hydrochloric Acid	7647-01-0		

The estimated annualized test costs for the 21 hazardous air pollutants are based on the tests recommended by the Environmental Protection Agency (see Table 24). Laboratory costs are estimated to range between 20.1 and 33.1 million dollars (see Table 25). In addition to laboratory costs, expenses associated with the administration of the testing program are incurred by the companies subject to the test rule. These administrative costs are estimated to be 25 percent of the laboratory costs (i.e., 5.0 to 8.3 million dollars). The total cost of testing, therefore, is the sum of laboratory and administrative costs, or 25.2 to 41.4 million dollars.

The total test costs are annualized using a cost of capital of seven percent over a period of 15 years, which is believed to be representative of the chemical industry. Thus, the annualized test costs range from 2.8 to 4.5 million dollars. These specific cost elements are summarized as follows (the detailed cost elements are summarized in Table 26):

COST ELEMENT	MINIMUM ($)	MAXIMUM ($)
Total Laboratory Costs	$20,148,320	$33,113,030
Total Administrative Costs	$ 5,037,080	$ 8,278,258
Total Test Costs	$25,185,400	$41,391,288
Total Annualized Test Costs	$ 2,765,222	$ 4,544,541

The objective of this report is to evaluate the economic impact of the recommended testing on these 21 hazardous air pollutants by determining if the proposed rule will have a significant adverse economic impact on each chemical's market. A preliminary determination of the potential for significant adverse impact can usually be made on the basis of the anticipated unit test costs for the manufacturers of each chemical.

In this evaluation, if the unit costs of testing a chemical are less than one percent of the sales price of the chemical, then the potential for adverse economic impact due to the proposed test rule is low. Unit test costs greater than one percent of the chemical's sales price may indicate a greater potential for adverse economic impact.

Based upon currently available public data, only two of the 21 compounds <u>may</u> exhibit a potential for adverse economic impact: carbonyl sulfide and 1,2,4-trichlorobenzene.

Carbonyl sulfide lacks any known full-scale commercial production in the United States; thus, no production data of any kind (CBI or non-CBI) is available. Furthermore, no trade statistics are available. It is, however, the most abundant sulfur-bearing compound in the atmosphere and is believed to originate from microbes, volcanoes, the burning of vegetation, and as a by-product of various industrial processes. In 1991, 16.7 million pounds of carbonyl sulfide were released into the environment as reported by the Toxic Release Inventory (TRI) (USEPA 1994b). Furthermore, no sales price data is available for any quantity other than for research purposes. Therefore, an estimate of the "supply volume" or "sales price" required to support testing at the one percent of price impact level is difficult to derive.

1,2,4-Trichlorobenzene has no non-CBI supply information; however, CBI production and import data does exist and, in 1990, totalled ########## pounds (CBI) (USEPA 1995). 1,2,4-Trichlorobenzene has list price of $1.25 per pound (CMR 1994a). <u>Trichlorobenzenes</u> are used as a component in some pesticides, as a dye carrier, in dielectric fluids, in lubricants, as a heat-transfer medium, and as an organic intermediate and solvent used in chemical manufacturing; however, the market for these uses is small and declining. Of the trichlorobenzenes, only 1,2,4-trichlorobenzene and 1,2,3-trichlorobenzene are sold in larger than research quantities (USEPA 1993n).

Assuming the sales price remains constant, a supply volume of 5.5 - 8.5 million pounds of 1,2,4-trichlorobenzene would be required to support testing at the one percent of price impact level. On the other hand, assuming the supply volume remains constant, a sales price of #### - #### per pound (CBI) would be required to support 1,2,4-trichlorobenzene testing at the one percent of price impact level.

Utilizing the current recommended testing scheme, Table 28 presents the sales price required to support testing at the one percent of sales price impact level for various hypothetical supply volumes for both carbonyl sulfide (where definitive supply data is unavailable) and 1,2,4-trichlorobenzene (where only CBI supply data is available).

With the currently available data, no conclusion is possible regarding the likelihood or degree of adverse economic impact of testing on the producers of **carbonyl sulfide**. However, the impact of testing on **1,2,4-trichlorobenzene** manufacturers is expected to be ######### (CBI) since the impact is estimated to be #### to #### percent of sales price (CBI).

II. PRODUCERS AND TRADE STATISTICS

A. BIPHENYL

Biphenyl (also known as diphenyl) is produced by the following four companies (USEPA 1994a):

o Chemol Co.	Greensboro, NC
o Koch Refining Co.	Corpus Christi, TX
o Monsanto Co.	Anniston, AL
o Sybron Chemicals	Wellford, SC

The USITC reported biphenyl's 1993 production as 58.7 million pounds; sales totalled 32 million pounds (USITC-SOC 1994b).

Biphenyl exports were not reported separately during 1990 - 1993; imports were reported only for 1992 and 1993, and totalled 1.6 and 0.6 million pounds, respectively (USDOC-EXP 1991-94; USDOC-IMP 1991-94).

Except for Monsanto, biphenyl is produced as a by-product of the hydrodealkylation (HDA) of toluene to benzene; approximately 1 kg of biphenyl is recovered from the higher boiling residues per 100 kg of benzene produced. Approximately half of biphenyl produced in 1990 was derived from HDA sources. High purity biphenyl is produced by Monsanto by the direct dehydrocondensation of benzene. By-product biphenyl is generally shipped in the molten state by tank car or tank truck. Higher purity grades are either sold in the molten state in tank truck or tank car lots or as flakes in bags or drums (USEPA 1994a).

The current list price for biphenyl ranges between $0.64 per pound (tanks, works) and $0.74 per pound (99% pure, carload, truckload, works) (CMR 1994a). Trade statistics are summarized in Table 1.

Table 1. Biphenyl Trade Statistics

Chemical Name and Trade Statistics	**1990 (000 lbs)**	**1991 (000 lbs)**	**1992 (000 lbs)**	**1993 (000 lbs)**
Biphenyl				
Production	53,604	na	na	58,668
Sales	23,435	17,955	na	32,034
Imports	na	na	1,587	578
Exports	na	na	na	na
Supply (P+I)	53,604	0	1,587	59,247
Price ($/lb)	0.00	0.00	0.00	0.64 - 0.74

Harmonized Tariff Schedule No. 2902.90.6000

Sources: CMR 1994a; USDOC-EXP 1991-94; USDOC-IMP 1991-94; USITC-SOC 1991, 1993, 1994a,b.

B. CARBONYL SULFIDE

Carbonyl sulfide is not produced in large quantities for commercial applications in the United States. It is, however, the most abundant sulfur-bearing compound in the atmosphere, although it is exceeded by hydrogen sulfide and sulfur dioxide in some industrial urban areas. Carbonyl sulfide is believed to originate from microbes, volcanoes, the burning of vegetation, and industrial processes. In industrial processes, carbonyl sulfide occurs as a by-product in the manufacture of carbon disulfide, in many manufactured fuel gases and refinery gases, and in combustion products of sulfur-containing fuels. It also tends to be concentrated in the propane fraction in gas fractionation which requires an amine sweetening process for its removal (Kirk-Othmer 1983).

According to the 1991 Toxic Release Inventory, 36 U.S.

facilities produced carbonyl sulfide as an impurity or a by-product. Of these, the following firm, at two different facilities, utilized carbonyl sulfide for on-site use/processing (USEPA 1994b):

o Sid Richardson Carbon and Gasoline Co.	West Baton Rouge, LA Big Springs, TX

No production volumes (CBI or non-CBI) are available for carbonyl sulfide (USEPA 1994b; USITC-SOC 1991, 1993, 1994a,b). Import and export data were, also, unavailable (USDOC-EXP 1991-94; USDOC-IMP 1991-94). No list prices were available due to the non-commercial nature of the compound (CMR 1994a). Although no trade statistics have been identified, as reflected in Table 2, in 1991, 16.7 million pounds of carbonyl sulfide were reportedly released into the environment (USEPA 1994b).

Table 2. Carbonyl Sulfide Trade Statistics

Chemical Name and Trade Statistics	**1991 (000 lbs)**	**1992 (000 lbs)**	**1993 (000 lbs)**
Carbonyl Sulfide			
Production	0	0	0
Imports	na	na	na
Exports	na	na	na
Supply (P+I)	0	0	0
Price ($/lb)	0.00	0.00	0.00

Harmonized Tariff Schedule No. (na)

Sources: CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USEPA 1994b; USITC-SOC 1993, 1994a,b.

C. CHLORINE

Chlorine is produced by the twenty-four companies displayed in Table 3 (USEPA 1994c).

In 1993, 23.9 billion pounds of chlorine were produced in the United States (BOC-CIR 1994). Imports and exports for 1993 were 646.9 and 81.3 million pounds, respectively (USDOC-EXP 1994; USDOC-IMP 1994).

The current list price for chlorine ranges between $225 and $255 per short ton (tanks, single units, works, fob, freight equalled) (CMR 1994a). This price range translates to $0.11 - $0.13 per pound. Trade statistics are summarized in Table 4.

Table 3. U.S. Manufacturers of Chlorine, 1993

Company Name	Location
Ashta Chemicals	Ashtabula, OH
Cedar Chemical Corp.	Vicksburg, MS
Dow Chemical USA	Freeport, TX
	Plaquemine, LA
Du Pont	Niagara Falls, NY
Elf Atochem North America, Inc.	Portland, OR
	Tacoma, WA
Formosa Plastics Corp. USA	Baton Rouge, LA
Fort Howard Corp.	Green Bay, WI
	Muskogee, OK
	Rincon, GA
General Electric Co.	Burkville, AL
	Mount Vernon, IN
Georgia Gulf Corp.	Plaquemine, LA
Georgia-Pacific Corp.	Bellingham, WA
	Brunswick, GA
The BF Goodrich Co.	Calvert City, KY
Hanlin Group, Inc.	Acme, NC
	Brunswick, GA
	Orrington, ME
La Roche Chemicals Inc.	Gramercy, LA
Magnesium Corp. of America	Rowley, UT
Miles Inc.	Baytown, TX
Niachlor Inc.	Niagara Falls, NY
Occidental Chemical Corp.	Convent, LA
	Corpus Christi, TX
	Deer Park, TX
	Delaware City, DE
	La Porte, TX
	Mobile, AL
	Muscle Shoals, AL
	Niagara Falls, NY
	Tacoma, WA
	Taft, LA
Olin Corp.	Augusta, GA
	Charleston, TN
	McIntosh, AL
Oregon Metallurgical Corp.	Albany, OR
Pioneer Chlor Alkali Co., Inc.	Henderson, NV
	St. Gabriel, LA
PPG Industries, Inc.	Lake Charles, LA
	Natrium, WV
Titanium Metals Corp.	Henderson, NV
Vulcan Materials Co.	Geismar, LA
	Port Edwards, WI
	Wichita, KS
Weyerhauser Co.	Longview, WA

Source: USEPA 1994c.

Table 4. Chlorine Trade Statistics

Chemical Name and Trade Statistics	1991 (000 lbs)	1992 (000 lbs)	1993 (000 lbs)
Chlorine			
Production	23,133,956	23,503,772	23,903,772
Imports	592,896	550,955	646,917
Exports	89,798	67,855	81,348
Supply (P+I)	23,726,852	24,054,727	24,550,689
Price ($/lb)	0.00	0.00	0.11 - 0.13

Harmonized Tariff Schedule No. 2801.10.0000

Sources: BOC-CIR 1993, 1994; CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94.

D. CHLOROBENZENE

Chlorobenzene (also known as monochlorobenzene) is produced by the following three companies (USEPA 1993a):

- o Monsanto Co. — Sauget, IL
- o Standard Chlorine of Delaware, Inc. — Delaware City, DE
- o PPG Industries, Inc. — Natrum, WV

In 1993, US production of chlorobenzene totalled 195.3 million pounds (USITC-SOC 1994b). Imports and exports for 1992 were 3.6 and 0.22 million pounds, respectively (USDOC-EXP 1992-94; USDOC-IMP 1992-94). The current list price for monochlorobenzene is $0.55 per pound (tanks, fob) (CMR 1994a). Trade statistics are summarized in Table 5.

Table 5. Chlorobenzene Trade Statistics

Chemical Name and Trade Statistics	1991 (000 lbs)	1992 (000 lbs)	1993 (000 lbs)
Chlorobenzene			
Production	210,170	231,913	195,264
Imports	43	149	3,601
Exports	572	208	220
Supply (P+I)	210,212	232,062	198,865
Price ($/lb)	0.00	0.00	0.55

Harmonized Tariff Schedule No. 2903.61.1000

Sources: CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USITC-SOC 1993, 1994a,b.

E. CHLOROPRENE

Chloroprene is produced by the following two companies (CMR 1994c):

o Du Pont	La Place, LA
	Louisville, KY
o Miles	Houston, TX

The USITC does not itemize production data for chloroprene. However, the production of chloroprene can be approximately equated to the amount of polychloroprene (neoprene) produced since chloroprene is used almost exclusively to manufacture polychloroprene. Excluding Russia, China, and former Eastern Bloc countries, in 1989, polychloroprene world production was 321,000 tons; approximately half of this was consumed in the US (i.e., 160,500 tons (metric?) or 352,902,500 pounds (assuming metric tons at 2,205 pounds per metric ton)) (USEPA 1993b).

In 1993, polychloroprene <u>demand</u> (sales plus imports) was estimated to be 70,000 metric tons (or 154,350 thousand pounds) (CMR 1994c). This volume will be used as an estimate of chloroprene supply for 1991.

Import and export data does not exist for chloroprene but does for polychloroprene rubbers (USDOC-EXP 1992-94; USDOC-IMP 1992-94).

The current list price for chloroprene has not been identified in published sources; however, the 1993 list price for polychloroprene ranged between $1.51 -1.81 per pound (CMR 1994c). This price range will be used in this analysis. Trade statistics for polychloroprene are summarized in Table 6.

Table 6. Polychloroprene Trade Statistics

Chemical Name and Trade Statistics	**1991 (000 lbs)**	**1992 (000 lbs)**	**1993 (000 lbs)**
Polychloroprene			
Production	na	na	na
Imports	14,521	17,344	22,224
Exports	92,053	86,470	81,635
Supply (P+I)	160,965	17,344	154,350
Price ($/lb)	1.51 - 1.81	0.00	1.51 - 1.81

Harmonized Tariff Schedule No. 4002.41.0000 (latex of chloroprene)
Harmonized Tariff Schedule No. 4002.49.0000 (chloroprene rubber, excl latex)

1991 & 1993 supply figures represent estimated domestic demand (sales plus imports).

Sources: CMR 1991b, 1994c; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USITC-SOC 1993, 1994a,b.

F. CRESOLS (mixed)

For this evaluation, cresols (mixed) refers to individual cresol isomers (i.e., meta, ortho, para) or specific cresol mixtures (e.g., meta/para mixtures). The commercial mixture of cresol isomers, in which the meta-isomer predominates, is sometimes referred to as cresylic acid or cresylics. Cresylic acids contain cresols and small amounts of phenols and xylenols and they are defined as those mixtures in which over 50% will boil above 204^{o}C (USEPA 1993c).

The following six companies have been identified as producing some type of cresols (mixed) (USEPA 1993c).

ortho-Cresol

o Aldrich Chemical Co.	Milwaukee, WI
o General Electric Co.	Selkirk, NY
o Merichem Co.	Houston, TX
o PMC, Inc.	Chicago, IL

meta-Cresol

o Aldrich Chemical Co.	Milwaukee, WI
o Merichem Co.	Houston, TX
o Rhone-Poulenc Inc.	Oil City, PA

para-Cresol

o Aldrich Chemical Co.	Milwaukee, WI
o Bell Flavors & Fragrances Inc.	Northbrook, IL
	Oakland, NJ
o Merichem Co.	Houston, TX
o PMC, Inc.	Chicago, IL

The USITC reported 1993 production of cresols to be 87.9 million pounds (USITC-SOC 1994b). Imports and exports for 1993 were 2.7 and 45.4 million pounds, respectively (USDOC-EXP 1994; USDOC-IMP 1994).

The current list price ($/lb) for the specific cresol isomers/mixtures was reported as follows (CMR 1994a):

m-cresol	$1.15	(95-98% drums, truckload, fob)
	$1.15	(tanks, fob)
o-cresol	$0.66 - 0.70	(99% pure drums, truckload, fob)
	$0.66 - 0.70	(bulk, fob)
p-cresol	$1.37	(98% drums, truckload, fob)
	$1.37	(bulk, fob)
m/p-cresol	$0.94	(99% drums, truckload, fob)
	$0.82	(bulk, fob)

The price range used for this report is $0.66 - $1.37 per pound. Trade statistics are summarized in Table 7.

Table 7. Cresols (mixed) Trade Statistics

Chemical Name and Trade Statistics	1990 (000 lbs)	1991 (000 lbs)	1992 (000 lbs)	1993 (000 lbs)
Cresols (mixed)				
Production	84,352	na	74,613	87,918
Imports	3,571	4,197	3,842	2,701
Exports	3,686	3,771	5,327	45,449
Supply (P+I)	87,924	4,197	78,455	90,619
Price ($/lb)	0.00	0.00	0.00	0.66 - 1.37

Harmonized Tariff Schedule No. 2707.99.3000 (m-cresol, o-cresol, p-cresol and m/p-cresol w/ purity of 75% or more by weight)

Sources: CMR 1994a; USDOC-EXP 1991-94; USDOC-IMP 1991-94; USITC-SOC 1991, 1993, 1994a,b.

G. DIETHANOLAMINE

Four firms produce ethanolamines (mono-, **di-**, and triethanolamine) (USEPA 1993d):

o Dow	Plaquemine, LA
	Midland, MI
o Occidental Petroleum	Bayport, TX
o Texaco	Port Neches, TX
o Union Carbide	Seadrift, TX

In 1993, the USITC reported a diethanolamine production volume of 215.9 million pounds (USITC-SOC 1994b).

The current list price for diethanolamine is $0.52 per pound (tanks, freight allowed) (CMR 1994a). Import, export, and other trade statistics are summarized in Table 8.

Table 8. Diethanolamine Trade Statistics

Chemical Name and Trade Statistics	1991 (000 lbs)	1992 (000 lbs)	1993 (000 lbs)
Diethanolamine			
Production	198,304	200,000 e	215,900
Sales	166,345	164,808	na
Imports	3,054	739	1,010
Exports	92,613	85,457	72,492
Supply (P+I)	201,359	200,739 e	216,911
Price ($/lb)	0.00	0.00	0.52

Harmonized Tariff Schedule No. 2922.12.0000 (diethanolamine and its salts).

1992 production volume is estimated (MCP 1993b).

Sources: CMR 1994a; MCP 1993b; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USITC-SOC 1993, 1994a,b.

H. ETHYL BENZENE

Ethylbenzene is produced by ten firms (USEPA 1993e):

o Amoco	Texas City, TX
o Arco	Channelview, TX
o Chevron	St. James, LA
o Cos-Mar	Carville, LA
o Dow	Freeport, TX
o Huntsman	Bayport, TX
o Koch	Corpus Christi, TX
o Rexene	Odessa, TX
o Sterling	Texas City, TX
o Westlake	Lake Charles, LA

In 1993, ethylbenzene had a production volume of 9,336 million pounds of which 34.9 million pounds were exported; an additional 78.3 million were imported (USDOC-EXP 1994; USDOC-IMP 1994; USITC-SOC 1994b).

Ethylbenzene sells for $0.16 per pound (bulk, fob, Houston, TX) (CMR 1994a). Table 9 summarizes various trade statistics.

Table 9. Ethyl Benzene Trade Statistics

Chemical Name and Trade Statistics	1991 (000 lbs)	1992 (000 lbs)	1993 (000 lbs)
Ethyl Benzene			
Production	8,872,539	11,110,389	9,335,606
Imports	6,835	11,876	78,282
Exports	196,112	121,039	34,864
Supply (P+I)	8,879,373	11,122,264	9,413,888
Price ($/lb)	0.00	0.00	0.16

Harmonized Tariff Schedule No. 2902.60.0000

Sources: CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USITC-SOC 1993, 1994a,b.

I. ETHYLENE DICHLORIDE

Eleven companies manufacture ethylene dichloride (CMR 1992c):

o Borden	Geismar, LA
o Dow	Freeport, TX
	Oyster Creek, TX
	Plaquemine, LA
o Formosa	Baton Rouge, LA
	Point Comfort, TX

o Georgia Gulf	Plaquemine, LA
o BF Goodrich	La Porte, TX
o OxyChem	Convent, LA
	Corpus Christi, TX
o Oxymar	Ingleside, TX
o PPG	Lake Charles, LA
o Vista	Lake Charles, LA
o Vulcan	Geismar, LA
o Westlake	Calvert City, KY

In 1993, ethylene dichloride had a production volume of 17,950 million pounds of which 2,317 million pounds were exported; an additional 276 million were imported (USDOC-EXP 1994; USDOC-IMP 1994; USITC-SOC 1994b).

Ethylene dichloride sells for $0.17 per pound (tanks, fob, works) (CMR 1994a). Table 10 summarizes various trade statistics.

Table 10. Ethylene Dichloride Trade Statistics

Chemical Name and Trade Statistics	1991 (000 lbs)	1992 (000 lbs)	1993 (000 lbs)
Ethylene Dichloride			
Production	13,715,107	15,152,882	17,949,930
Imports	10,842	300,025	276,109
Exports	1,456,894	1,808,999	2,316,639
Supply (P+I)	13,725,948	15,452,847	18,226,039
Price ($/lb)	0.00	0.00	0.17

Harmonized Tariff Schedule No. 2903.15.0000

Sources: CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USITC-SOC 1993, 1994a,b.

J. ETHYLENE GLYCOL

Ethylene glycol is produced by the ten firms listed below (USEPA 1993f):

o BASF	Geismar, LA
o Dow	Plaquemine, LA
	Fort Saskatchewan, Canada
o Eastman	Longview, TX
o Hoechst Celanese	Clear Lake, TX
o Oxy Petrochemicals	Bayport, TX
o PD Glycol	Beaumont, TX
o Quantum	Morris, IL
o Shell	Geismar, LA
o Texaco	Port Neches, TX
o Union Carbide	Taft, LA
	Seadrift, TX
	Prentiss, Canada

Montreal, Canada

Ethylene glycol had a 1993 production volume of 5,201 million pounds, of which 996.3 million pounds were exported and an additional 377 million pounds were imported (USDOC-EXP 1994; USDOC-IMP 1994; USITC-SOC 1994b).

The current list price for ethylene glycol ranges between $0.20 per pound (industrial, tanks, freight allowed) and $0.24 per pound (polyester, tanks, fob) (CMR 1994a). Trade statistics are summarized in Table 11.

Table 11. Ethylene Glycol Trade Statistics

Chemical Name and Trade Statistics	**1991 (000 lbs)**	**1992 (000 lbs)**	**1993 (000 lbs)**
Ethylene Glycol			
Production	4,810,357	5,129,167	5,201,222
Imports	511,247	395,143	376,995
Exports	912,424	873,682	996,342
Supply (P+I)	5,321,605	5,524,310	5,578,217
Price ($/lb)	0.00	0.00	0.20 - 0.24

Harmonized Tariff Schedule No. 2905.31.0000

Sources: CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USITC-SOC 1993, 1994a,b.

K. HYDROCHLORIC ACID

Forty-three firms covering 85 locations produce hydrochloric acid (USEPA 1994e). Table 12 presents a list of manufacturers for 1993.

In 1993, 6,981 million pounds of hydrochloric acid were produced in the United States (BOC-CIR 1994); 152.9 million pounds were imported and 88.4 million pounds were exported (USDOC-EXP 1994; USDOC-IMP 1994).

The current list price for hydrochloric acid varies by geographic region and technical grade (usually 18, 20, 22, 23^{o} Be', corresponding to approximately 28, 31, 35, 37% HCL, respectively). The list prices are $/ton (tanks, works) and are as follows (CMR 1994a):

Region	20^{o} Be'	22^{o} Be'
East	$ 65 - 80	$ 78 - 86
Gulf	$ 75	$ 85
Midwest	$ 75	$ 85
West	$100 - 105	$110 - 115

Table 12. U.S. Manufacturers of Hydrochloric acid, 1993

Company Name	Location
Akzo Chemicals Inc.	Edison, NJ Gallipolis Ferry, WV
Allied-Signal Inc.	Baton Rouge, LA Danville, IL El Segundo, CA
Ausimont USA, Inc.	Thorofare, NJ
BASF Corp.	Geismar, LA
Borden Chemicals & Plastics Partnership	Geismar, LA
Cabot Corp.	Tuscola, IL
CIBA-GEIGY Corp.	McIntosh, AL St. Gabriel, LA
Degussa Corp.	Theodore, Al Waterford, NY
Detrex Corp.	Ashtabula, OH
Dover Chemical Corp.	Dover, OH
Dow Chemical U.S.A.	Freeport, TX Midland, MI Oyster Creek, TX Pittsburg, CA Plaquemine, LA La Porte, TX
Dow Corning Corp.	Carrollton, KY Midland, MI
Du Pont	Parkersburg, WV Antioch, CA Corpus Christi, TX Deepwater, NJ Louisville, KY Montague, MI La Place, LA
Elf Atochem North America, Inc.	Portland, OR Tacoma, WA Calvert City, KY Wichita, KS Riverview, MI
Ferro Corp.	Hammond, IN
FMC Corp.	Baltimore, MD Nitro, WV
Formosa Plastics Corp. U.S.A.	Baton Rouge, LA Point Comfort, TX
General Electric Co.	Mount Vernon, IN Waterford, NY
Georgia Gulf Corp.	Plaquemine, LA
The BF Goodrich Co.	La Porte, TX
Hanlin Group, Inc.	Acme, NC Brunswick, GA Orrington, ME

Table 12. U.S. Manufacturers of Hydrochloric acid, 1993 (continued)

Company Name	Location
ICI Americas Inc.	Cold Creek, Al Geismar, LA Mount Pleasant, TN
ISK Biotech	Greens Bayou, TX
Jones-Hamilton Co.	Waldbridge, OH
La Roche Chemicals Inc.	Gramercy, LA
Magnesium Corp. of America	Rowley, UT
Magnetics International Inc.	Burns Harbor, IN
Miles Inc.	Baytown, TX New Martinsville, WV
Monsanto Co.	Bridgeport, NJ Sauget, IL
Occidental Chemical Corp.	Belle, WV Deer Park, TX Niagara Falls, NY Tacoma, WA
Olin Corp.	Augusta, GA Charleston, TN Lake Charles, LA
Oxymar	Ingleside, TX
Pioneer Chlor Alkali Co., Inc.	Henderson, NV
PPG Industries, Inc.	Barberton, Ohio Lake Charles, LA Natrium, WV La Porte, TX
Rhone-Poulenc Ag Co.	Institute, WV
Shell Chemical Co.	Norco, LA
Standard Chlorine Chemical Co., Inc.	Delaware City, DE
Velsicol Chemical Corp.	Chattanooga, TN Memphis, TN
Vista Chemical Co.	Baltimore, MD Lake Charles, LA
Vulcan Materials Co.	Geismar, LA Port Edwards, WI Wichita, KS
Westlake Monomers Corp.	Calvert City, KY
Weyerhauser Co.	Longview, WA
Witco Corp.	Phillipsburg, NJ

Source: USEPA 1994e.

As shown above, hydrochloric acid prices range between $65 and $115 per ton (tanks, works). This price range translates to $0.0325 - $0.0575 per pound. Trade statistics are summarized in Table 13.

Table 13. Hydrochloric Acid Trade Statistics

Chemical Name and Trade Statistics	1991 (000 lbs)	1992 (000 lbs)	1993 (000 lbs)
Hydrochloric Acid			
Production	6,758,812	7,215,920	6,980,565
Imports	622,862	490,454	152,923
Exports	78,613	94,632	88,440
Supply (P+I)	7,381,674	7,706,374	7,133,488
Price ($/lb)	0.00	0.00	0.03 - 0.06

Harmonized Tariff Schedule No. 2806.10.0000

Sources: BOC-CIR 1993, 1994; CMR 1994a USDOC-EXP 1992-94; USDOC-IMP 1992-94.

L. HYDROGEN FLUORIDE

Three companies manufacture hydrogen fluoride (USEPA 1993g):

- o Allied-Signal — Geismar, LA
- o Atochem North America — Calvert City, KY
- o Du Pont — La Porte, TX

In 1993, 341.2 million pounds of hydrogen fluoride were produced in the U.S. (BOC-CIR 1994); an additional 138.8 million pounds were imported and 20 million pounds were exported (USDOC-EXP 1994; USDOC-IMP 1994).

Hydrogen fluoride sells for $52 per 100 pounds (aqueous, 70% tanks, fob, freight allowed) (CMR 1994a) or $0.52 per pound. Table 14 summarizes various trade statistics.

Table 14. Hydrogen Fluoride Trade Statistics

Chemical Name and Trade Statistics	1991 (000 lbs)	1992 (000 lbs)	1993 (000 lbs)
Hydrogen Fluoride			
Production	323,813	362,632	341,173
Imports	209,740	155,313	138,801
Exports	17,784	16,867	20,036
Supply (P+I)	533,553	517,945	479,974
Price ($/lb)	0.00	0.00	0.52

Harmonized Tariff Schedule No. 2811.11.0000

Sources: BOC-CIR 1993, 1994; CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94.

M. MALEIC ANHYDRIDE

Maleic anhydride is produced by (USEPA 1993h):

o Amoco	Joliet, IL
o Aristech	Neville Island, PA
o Ashland	Neal, WV
o Miles	Houston, TX
o Monsanto	Pensacola, FL

Of the 358.5 million pounds of maleic anhydride produced in 1993, 55.8 million pounds were exported; an additional 16.1 million pounds were imported (USDOC-EXP 1994; USDOC-IMP 1994; USITC-SOC 1994b).

Maleic anhydride is available as briquettes and capulets, and in molten form (USEPA 1993h). The current list price for maleic anhydride ranges from $0.48 to $0.50 per pound (bags, truckload, works, freight equalled) and $0.51 per pound (tanks, works, freight equalled) (CMR 1994a). Trade statistics are summarized in Table 15.

Table 15. Maleic Anhydride Trade Statistics

Chemical Name and Trade Statistics	1991 (000 lbs)	1992 (000 lbs)	1993 (000 lbs)
Maleic Anhydride			
Production	380,861	436,023	358,491
Imports	7,853	11,900	16,092
Exports	20,924	56,342	55,773
Supply (P+I)	388,714	447,924	374,583
Price ($/lb)	0.00	0.00	0.48 - 0.51

Harmonized Tariff Schedule No. 2917.14.1000 (derived from aromatics)
Harmonized Tariff Schedule No. 2917.14.5000 (derived from other)

Sources: CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USITC-SOC 1993, 1994a,b.

N. METHYL ISOBUTYL KETONE

Methyl isobutyl ketone is produced by the following three firms (USEPA 1993i):

o Eastman	Kingsport, TN
o Shell	Deer Park, TX
o Union Carbide	Institute, WV

Methyl isobutyl ketone had a 1993 production volume of 150.1 million pounds; an additional 14.8 million pounds were imported

(USDOC-IMP 1994; USITC-SOC 1994b). Exports were 30.4 million pounds in 1993 (USDOC-EXP 1994).

The current list price for methyl isobutyl ketone varies by geographic region. The list prices are $/pound (tanks, delivered) and are as follows (CMR 1994a):

Zone 1 (East)	$0.51
Zone 2 (CA, AZ)	$0.53
Zone 3 (other West of Rockies)	$0.53

As shown above, prices range between $0.51 and $0.53 per pound (tanks, delivered). Trade statistics are summarized in Table 16.

Table 16. Methyl Isobutyl Ketone Trade Statistics

Chemical Name and Trade Statistics	**1991 (000 lbs)**	**1992 (000 lbs)**	**1993 (000 lbs)**
Methyl Isobutyl Ketone			
Production	180,918	164,273	150,072
Imports	7,040	21,633	14,790
Exports	34,352	37,876	30,355
Supply (P+I)	187,958	185,906	164,862
Price ($/lb)	0.00	0.00	0.51 - 0.53

Harmonized Tariff Schedule No. 2914.13.0000

Sources: CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USITC-SOC 1993, 1994a,b.

O. METHYL METHACRYLATE

Three firms produce methyl methacrylate (CMR 1994b; USEPA 1993j):

o Cyro Industries	Fortier, LA
o ICI	Beaumont, TX
	Memphis, TN
o Rohm and Haas	Deer Park, TX

There were 1,148 million pounds of methyl methacrylate produced in 1993 of which 104.2 million pounds were exported (USDOC-EXP 1994; USITC-SOC 1994b). Imports were 26.9 million pounds in 1993 (USDOC-IMP 1994).

Methyl methacrylate sells for $0.71 per pounds (tanks, delivered) (CMR 1994a). Table 17 summarizes various trade statistics.

Table 17. Methyl Methacrylate Trade Statistics

Chemical Name and Trade Statistics	1991 (000 lbs)	1992 (000 lbs)	1993 (000 lbs)
Methyl Methacrylate			
Production	1,102,037	1,207,952	1,148,428
Imports	3,161	10,200	26,880
Exports	109,427	119,931	104,181
Supply (P+I)	1,105,198	1,218,152	1,175,308
Price ($/lb)	0.00	0.00	0.71

Harmonized Tariff Schedule No. 2916.14.0020

Sources: CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USITC-SOC 1993-94.

P. NAPHTHALENE

The following three firms manufacture naphthalene (CMR 1993e; USEPA 1993k):

- o Advanced Aromatics — Baytown, TX
- o Allied Signal — Ironton, OH
- o Koppers — Follansbee, WV

There were 273.6 million pounds of naphthalene produced in 1992 (no production data was published for 1993); imports accounted for another 16.1 million pounds while exports totalled 5.6 million pounds in 1992 (USDOC-EXP 1993; USDOC-IMP 1993; USITC-SOC 1994a,b).

Naphthalene's current list price ranges between $0.29 and $0.40 per pound. Three categories of products exist:

- domestic, 78 deg., tanks, works — $0.29 - 0.30 / pound
- petroleum, 80 deg., tanks, fob — $0.39 - 0.40 / pound
- refined, balls, flake, wholesalers drums, works — $0.39 - 0.40 / pound

Trade statistics for naphthalene are summarized in Table 18.

Q. PHENOL

The eleven phenol producers include (USEPA 1994f):

- o Allied Signal — Frankford, PA
- o Aristech — Haverhill, OH
- o BTL — Blue Island, IL

Table 18. Naphthalene Trade Statistics

Chemical Name and Trade Statistics	1991 (000 lbs)	1992 (000 lbs)	1993 (000 lbs)
Naphthalene			
Production	na	273,585	na
Imports	15,314	16,142	5,573
Exports	3,261	5,605	4,071
Supply (P+I)	15,314	289,728	5,573
Price ($/lb)	0.00	0.00	0.29 - 0.40

Harmonized Tariff Schedule No. 2707.40.0000

Sources: CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USITC-SOC 1993, 1994a,b.

o Dakota Gasification	Beulah, ND
o Dow	Freeport, TX
o General Electric	Mount Vernon, IN
o Georgia Gulf	Pasadena, TX
	Plaquemine, LA
o Kalama	Kalama, WA
o Merichem	Houston, TX
o Shell	Deer Park, TX
o Texaco	El Dorado, KS

In 1993, the USITC reported a production volume of 3,405 million pounds for phenol (USITC-SOC 1994b). The 1993 imports and exports were 42.0 and 228.5 million pounds, respectively (USDOC-EXP 1994; USDOC-IMP 1994).

Phenol (synthetic, tanks, freight equalled) sells for $0.28 - 0.33 per pound (CMR 1994a). Table 19 summarizes the trade statistics.

Table 19. Phenol Trade Statistics

Chemical Name and Trade Statistics	1991 (000 lbs)	1992 (000 lbs)	1993 (000 lbs)
Phenol			
Production	3,597,722	3,886,271	3,405,010
Imports	11,539	20,804	42,049
Exports	161,298	248,427	228,475
Supply (P+I)	3,609,261	3,907,075	3,447,058
Price ($/lb)	0.00	0.00	0.28 - 0.33

Harmonized Tariff Schedule No. 2907.11.000 (phenol and its salts)

Sources: CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USITC-SOC 1993, 1994a,b.

R. PHTHALIC ANHYDRIDE

Phthalic anhydride is produced by these five companies (USEPA 1993l):

o Aristech	Pasadena, TX
o Exxon	Baton Rouge, LA
o Koppers	Cicero, IL
o Stepan	Millsdale, IL
o Sterling	Texas City, TX

There were 853.6 million pounds of phthalic anhydride produced in 1993 of which 37.5 million pounds were exported; an additional 63.4 million pounds were imported (USDOC-EXP 1994; USDOC-IMP 1994; USITC-SOC 1994b).

Phthalic anhydride is available in flakes or molten form and price varies accordingly:

- flake carload, truckload, drums, freight equalled	$0.35 - 0.45 / pound
- tanks, freight equalled	$0.33 - 0.35 / pound

The price range used for this report is $0.33 - $0.45 per pound. Trade statistics are summarized in Table 20.

Table 20. Phthalic Anhydride Trade Statistics

Chemical Name and Trade Statistics	1991 (000 lbs)	1992 (000 lbs)	1993 (000 lbs)
Phthalic Anhydride			
Production	587,141	898,207	853,584
Imports	27,938	53,060	63,425
Exports	77,671	46,252	37,549
Supply (P+I)	615,078	951,267	917,010
Price ($/lb)	0.00	0.00	0.33 - 0.45

Harmonized Tariff Schedule No. 2917.35.0000

Sources: CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USITC-SOC 1993, 1994a,b.

S. 1,2,4-TRICHLOROBENZENE

1,2,4-Trichlorobenzene is produced by Standard Chlorine of Delaware (Delaware City, DE), where it is both sold and used as a formulating ingredient. All chlorobenzenes are presently produced by the catalytic chlorination of benzene, an ortho-, para-directed reaction. Therefore, 1,2,4-trichlorobenzene may be produced as a by-product or an impurity in the production of large production chlorobenzenes such as monochlorobenzene, o-dichlorobenzene, and p-dichlorobenzene (USEPA 1993m).

According to the 1991 Toxic Chemical Release Inventory (TRI) submissions, there are 11 facilities that manufacture or import 1,2,4-trichlorobenzene, nine facilities that manufacture 1,2,4-trichlorobenzene, and three facilities that import 1,2,4-trichlorobenzene. The additional producers of 1,2,4-trichlorobenzene are:

o Monsanto Co.	(Sauget, IL) which produces it as a by-product;
o Occidental Chemical	(High Point, NC) which imports it for on-site use as a formulating ingredient;
o PPG Industries	(Westlake, LA and New Martinsville, WV) which produces it as a by-product and for sale;
o Sandoz Agro Inc.	(Beaumont, TX) which imports it for on-site use a sa reactant;
o Sun Ref. & Mrktg Co.	(Marcus Hook, PA) which produces and imports chemicals in which it is an impurity;
o Vista Chemical Co.	(Westlake, LA) which produces it as a by-product;
o Virkler Co.	(Charlotte, NC) which produces it for sale and uses it as a formulating ingredient;
o Westlake Monomers	(Calvert City, KY) which produces it for on-site use as a reactant (USEPA 1993m).

No non-CBI production, export, or import information is available for 1,2,4-trichlorobenzene (USDOC-EXP 1991-93; USDOC-IMP 1991-93; USITC-SOC 1991, 1993, 1994a,b); however, CBI supply data does exist. In 1990, ######### pounds (CBI) of 1,2,4-trichlorobenzene were produced with an additional ######### pounds (CBI) being imported (USEPA 1995).

1,2,4-Trichlorobenzene (pure, tanks, delivered) sells for $1.25 per pound (CMR 1994a). Table 21 summarizes the trade statistics.

T. 1,1,2-TRICHLOROETHANE

1,1,2-Trichloroethane is produced by two firms (USEPA 1994g):

- o Dow Chemical USA — Freeport, TX
- o PPG Industries, Inc. — Lake Charles, LA

Table 21. 1,2,4-Trichlorobenzene Trade Statistics

Chemical Name and Trade Statistics	**1990 (000 lbs)**	**1991 (000 lbs)**	**1992 (000 lbs)**	**1993 (000 lbs)**
1,2,4-Trichloroethane				
Production	CBI	na	na	na
Imports	CBI	na	na	na
Exports	na	na	na	na
Supply (P+I)	CBI	0	0	0
Price ($/lb)	0.00	0.00	0.00	1.25

Harmonized Tariff Schedule No. (na) (basket category 2903.69.1000)

Sources: CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USEPA 1995; USITC-SOC 1993, 1994a,b.

It is produced primarily as a co-product of various chlorination processes, such as the manufacture of 1,2-dichloroethane and the chlorination of ethane or 1,1-dichloroethane to produce 1,1,1-trichloroethane. 1,1,2-trichloroethane is also produced when co-product sources are inadequate or for balancing feedstocks. The liquid-phase chlorination of 1,2-dichloroethane is an often-used route for synthesizing 1,1,2-trichloroethane (USEPA 1994g).

No non-CBI production, export, or import information was available for 1,1,2-trichloroethane (USDOC-EXP 1991-94; USDOC-IMP 1991-94; USEPA 1994g; USITC-SOC 1991, 1993, 1994a,b). Demand for 1,1,2-trichloroethane can be estimated from vinylidene chloride production since the primary use of 1,1,2-trichloroethane is to produce vinylidene chloride and since vinylidene chloride is produced almost exclusively from 1,1,2-trichloroethane. Since the U.S. demand for vinylidene chloride in 1987 was 68,000 metric tons (149,940 thousand pounds) and was projected to rise to 79,000 metric tons (174,195 thousand pounds) in 1992, the corresponding 1987 demand and 1992 projected demand for 1,1,2-trichloroethane would be 94,000 metric tons (207,270 thousand pounds) and 110,000 metric tons (242,550 thousand pounds), respectively, assuming a 100 percent yield (USEPA 1994g).

The list price (tanks, fob, works) is $0.42 per pound for 1,1,2-trichloroethane (CMR 1994a). The available trade statistics are contained in Table 22.

U. VINYLIDENE CHLORIDE

Vinylidene chloride is produced by two firms (USEPA 1994h):

o Dow Chemical USA — Freeport, TX
o PPG Industries, Inc. — Lake Charles, LA

Table 22. 1,1,2-Trichloroethane Trade Statistics

Chemical Name and Trade Statistics	**1991 (000 lbs)**	**1992 (000 lbs)**	**1993 (000 lbs)**
1,1,2-Trichloroethane			
Production	na	242,550 e	na
Imports	na	na	na
Exports	na	na	na
Supply (P+I)	0	242,550 e	0
Price ($/lb)	0.00	0.00	0.42

Harmonized Tariff Schedule No. (na) (basket category 2903.19.5000)

Sources: CMR 1994a; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USEPA 1994g; USITC-SOC 1993, 1994a,b.

It is almost exclusively produced from 1,1,2-trichloroethane, primarily by liquid-phase dechlorination in the presence of alkali (USEPA 1994h).

No non-CBI production information is available for vinylidene chloride (USEPA 1994h; USITC-SOC 1991, 1993, 1994a,b). In 1987, the U.S. demand for vinylidene chloride was 68,000 metric tons (149,940 thousand pounds) and was projected to rise to 79,000 metric tons (174,195 thousand pounds) in 1992. One industry source estimated the 1989 production volume to be 230 million pounds (USEPA 1994h).

The list price for vinylidene chloride monomer (bulk, Freeport, TX) is $0.37 per pound (Dow 1994). Published and estimated trade statistics are shown in Table 23.

Table 23. Vinylidene Chloride Trade Statistics

Chemical Name and Trade Statistics	**1991 (000 lbs)**	**1992 (000 lbs)**	**1993 (000 lbs)**
Vinylidene Chloride			
Production	na	174,195 e	na
Imports	3,293	4,995	7,234
Exports	16,246	19,122	19,726
Supply (P+I)	3,293	179,190 e	7,234
Price ($/lb)	0.00	0.00	0.37

Harmonized Tariff Schedule No. 3904.50.0000 (vinylidene chloride polymers)
Harmonized Tariff Schedule No. (na) (monomer in basket category 2903.29.0000)

Sources: CMR 1994a; Dow 1994; USDOC-EXP 1992-94; USDOC-IMP 1992-94; USEPA 1994h; USITC-SOC 1993, 1994a,b.

III. USES AND MARKET TRENDS

A. BIPHENYL

Biphenyl is used as a heat transfer agent, a dye carrier for polyesters, a feedstock, especially in the production of alkylbiphenyls, and a citrus fruit wrapping impregnate to reduce spoilage.

One common heat transfer fluid, Dowtherm A, is a eutectic mixture containing 26.5% biphenyl and 73.5% diphenyl ether. About 10% of the by-product biphenyl is consumed as technical grade (93-95%) material as a textile dye carrier and the rest is used as an alkylation feedstock or purified and used as a heat transfer agent. High purity biphenyl from the dehydrocondensation of benzene is used as a heat transfer agent or alkylated. Alkylated biphenyls are used as heat transfer agents and dielectric fluids in condensers (USEPA 1994a).

Biphenyl is listed as an important and commonly found food preservative. The U.S. FDA lists it as a flavor enhancer or adjuvant. The label notation for biphenyl is E230 and the recommended concentration range is 50-70 ppm (USEPA 1994a).

The use of biphenyl as a dye carrier in the textile industry has been on the decline because of environmental concerns over the amount of biphenyl released in wastewater effluents by the many plants that dye textiles. Biphenyl in these effluents may be converted to PCBs during chlorination of wastewater (USEPA 1994a).

Formerly, biphenyl was chlorinated to form polychlorinated biphenyls (PCBs) for use as a nonflammable hydraulic fluid and transformer dielectric. Production of PCBs ceased precipitously in 1972 when they were recognized as serious environmental contaminants (USEPA 1994a).

No market trend or growth rate data have been located as of yet for biphenyl.

B. CARBONYL SULFIDE

Carbonyl sulfide's commercial importance is limited. It is not manufactured in large quantities and is used only for small scale-synthesis and experiments. Previous applications included the synthesis of thio organic compounds, such as the herbicide triallate (USEPA 1994b).

C. CHLORINE

Chlorine is one of the top 50 industrial chemicals in the US, ranking 9th and 10th for 1991 and 1992, respectively (C&EN 1993). It is used primarily as a raw material for a wide variety of organic and inorganic compounds. The 1993 estimated end-use pattern for chlorine is (MCP 1993a):

Derivative	Percent
Ethylene dichloride / vinyl chloride monomer	35
Pulp & paper	11
Propylene oxide	8
Chlorinated ethanes	5
Chlorinated methanes	4
Other organic chemicals	16
Inorganic chemicals	11
Water treatment	5
Miscellaneous	5

Over one third of all chlorine production is used in the manufacture of polyvinyl chloride (PVC) via ethylene dichloride (EDC). EDC is an intermediate for vinyl chloride monomer and PVC resins. The second largest application is as a bleach in the pulp and paper industry (MCP 1993a).

Chlorine is consumed in the manufacture of propylene oxide (via the chlorohydrin process) which is used in polyurethane products and propylene glycols. It is also used to make phosgene, a raw material for isocyanates (CMR 1992a; MCP 1993a).

Numerous organic and inorganic compounds are synthesized utilizing chlorine. Many of the organics find uses as solvents in metal cleaning, dry cleaning, CFC/HCFC production, etc. Chlorine is used in the production of propylene oxide, carbon tetrachloride, perchloroethylene, hypochlorite, epichlorohydrin, 1,1,1-trichloroethane, methylene chloride, ethylene dichloride (solvent and trade), trichloroethylene, chlorobenzene, chloroprene, bromine, and numerous other organic compounds. Inorganic compounds include titanium oxide and hydrochloric acid (CMR 1992a; MCP 1993a; USEPA 1994c).

Chlorine is a slimicide and a sanitizing and disinfecting agent for municipal water supplies and swimming pools. Chlorine is also used as an etching gas in the semiconductor industry. Chlorine is used in sewage treatment and in the pharmaceutical and textile industries (USEPA 19994c).

Mature end-uses and increasing environmental regulation will continue to impact future chlorine demand by declining consumption in pulp bleaching, CFCs, and chlorinated solvents, and growing demand in polyvinyl chloride intermediates, titanium dioxide, and phosgene. Historically, chlorine grew at a rate of 2.5 percent per year from 1982 through 1991; however, future growth is projected to be about 0.5 percent per year through 1996 (CMR 1992a; MCP 1993a).

D. CHLOROBENZENE

Chlorobenzene (also known as monochlorobenzene) is used in a range of products. The 1993 estimated end-use pattern for chlorobenzene is (CMR 1993a):

Derivative	Percent
Nitrochlorobenzenes	50
Solvents	23
Diphenyl oxide and phenylphenols	22
Polysulfone polymers	4
Miscellaneous	1

Chlorobenzene is used largely in the production of nitrochlorobenzene, which, in turn, is used in the manufacture of dyes and pigments, rubber processing chemicals, antioxidants, pesticides, and pharmaceuticals. It is also used as a solvent in herbicide formulations and other agricultural products, in isocyanate processing, and in degreasing (CMR 1993a; MCP 1990; USEPA 1993a).

In the past, large amounts of chlorobenzene were used to manufacture phenol, aniline, and DDT. However, these uses have essentially disappeared due to the adoption of new processes and the phase-out of DDT (USEPA 1993a).

Historically, chlorobenzene grew at a rate of minus 1 percent per year from 1983 through 1992; however, future growth is projected to be about 2 percent per year through 1995, but a potential fall off late in the decade (CMR 1993a; MCP 1993a).

E. CHLOROPRENE

Used almost entirely in the production of polychloroprene (i.e., neoprene) synthetic rubbers, chloroprene's only other use of significant volume is the manufacture of 2,3-dichloro-1,3-butadiene which is used as a monomer in chloroprene copolymerizations (USEPA 1993b).

Since chloroprene is used almost entirely in the production of polychloroprene, the 1993 estimated end-use pattern for polychloroprene is (CMR 1994c):

Derivative	Percent
Industrial (belts, hosing, flooring)	33
Mechanical	30
Adhesives	10
Latexes	10
Wire and Cable	6
Cellular rubber	4
Miscellaneous (incl. consumer goods)	7

Polychloroprene, historically, grew at a rate of <u>minus</u> 3 percent per year from 1984 through 1993; however, future growth is projected to range between 0 and 1 percent per year through 1998 (CMR 1994c).

F. <u>CRESOLS (mixed)</u>

Specific end-use patterns for the each cresol isomer/mixture have not been identified but are discussed below. However, the estimated 1993 end-use pattern for cresylics (which includes cresols and cresylic acids) is as follows (CMR 1993b):

Derivative	Percent
Exports	35
Antioxidants	20
Phenolic, epoxy, novolac resins	15
Wire and enamel solvent	12
Phosphate esters	5
Intermediate	5
Miscellaneous (incl. cleaning & disinfectant cmpds and ore flotation)	8

ortho-Cresol is primarily used as either a solvent or disinfectant. It is also used as a chemical intermediate for a wide variety of products including 2-methylcyclohexanol, 2-methylcyclohexanone, coumarin, and 3-isopropyl-6-methyl phenol (carvacrol). ortho-Cresol is also used in the manufacture of several antioxidants, dyes, and in the formation of epoxy-o-cresol novolac (ECN) resins. ECN resins are sealing materials for integrated circuits (silicon chips). ortho-Cresol is also used as an additive to phenol-formaldehyde resins. Furthermore, the manufacture of certain herbicides and pesticides, including 4-

chloro-2-methylphenoxyacetic acid (MCPA), 2-(4-chloro-2-methylphenoxy)-propionic acid (MCPP), .g.-(4-chloro-2-methylphenoxy)-butyric acid (MCPB), and 4,6-dinitro-o-cresol (DNCO), is dependent upon ortho-cresol (USEPA 1993c).

meta-Cresol, either pure or mixed with para-cresol, is important in the production of contact herbicides such as O,O-dimethyl-O-(3-methyl-4-nitrophenyl) thionophosphoric acid (fenitrothion) and O,O-dimethyl-O-(3-methyl-4-methyl thiophenyl)thionophosphoric acid ester (fenthion). meta-Cresol is also used as a precursor to pyrethroid insecticides. Many flavor and fragrance compounds, such as (-)-methanol and musk amberette, are derived from meta-cresol. Furthermore, meta-cresol is used in the manufacture of the explosive, 2,4,6-trinitro-m-cresol (USEPA 1993c).

para-Cresol is largely used in the production of antioxidants such as 2,6-di-tert-butyl-p-cresol (BHT), 2,6-dicyclopentyl-p-cresol, 2,2'-methylene- or 2,2'-thiodiphenols, and Tinuvin 326. Tinuvin 326 is a substituted hydroxyphenyl benzotriazole which is an absorber of UV light and is used in films and coatings. para-Cresol also has many applications in the fragrance and dye industries. para-Cresol carboxylic acid esters and anisaldehyde are used in perfumes (USEPA 1993c).

Mixtures of meta- and para-cresol often serve as disinfectants and preservatives. Cresols are added to soaps and disinfectants. They are used as wood preservatives, in ore flotation, and in fiber treatment. meta- and para-Cresol mixtures are used in the manufacture of tricresyl phosphate and diphenyl cresyl phosphate, which are used in flame-retardant plasticizers for polyvinylchloride (PVC) and other plastics, fire-resistant hydraulic fluids, additives for lubricants, and air filters. Cresols are used in paints, textiles, modifying phenolic resins, as solvents for synthetic resin coatings such as wire enamels, metal degreasers, and cutting oils, and as agents to remove carbon deposits from combustion engines (USEPA 1993c).

Although growth rates for the individual cresols have not been identified, cresylics, historically, grew at a rate of minus 3 percent per year from 1983 through 1992; however, future growth is projected to range between 0 and minus 1 percent per year through 1997 (CMR 1993b).

G. DIETHANOLAMINE

The 1992 use pattern for ethanolamines is as follows (MCP 1993b):

Derivative	Percent
Detergents	38
Gas purification	25
Ethylene amines	14
Corrosion inhibitors & Metal working	11
Miscellaneous (including cement grinding oils, agricultural chemicals, and synthesis)	12

Diethanolamine is used as a chemical intermediate in the production of surfactants, personal care products such as creams, lotions, shampoos, soaps and cosmetics, and detergents. Alkanolamine-based surfactants are generally alkanolamides (nonionic surfactants) and alkanolamine salts (anionic surfactants). It is used in adhesives, cleaners, coatings, corrosion inhibitors for ferrous metals in applications such as coolant systems, lubricating oils, metal working fluids, petroleum antifouling and drilling, and electroplating baths. It is used for "sweeting" natural gas and neutralizing acid herbicides. DEA or its derivatives are also used in many facets of textile production (USEPA 1993d).

Most end-uses for ethanolamines are mature. Long term growth is expected to be moderate. Over the next five years, growth will probably not exceed 3 percent per year (MCP 1993b).

H. ETHYL BENZENE

Ethyl benzene is one of the top 50 industrial chemicals in the US, ranking 20th and 18th for 1991 and 1992, respectively (C&EN 1993). Over 99 percent of ethylbenzene is used captively in the manufacture of styrene, which, in turn, is used to produce a variety of plastic and resin materials, the largest being polystyrene. The remainder is used in other applications, such as a solvent in the paint industry, as an intermediate for dyes, diethylbenzene, acetophenone, and ethyl anthraquinone. Ethylbenzene is a component of gasoline (MCP 1993c; USEPA 1993e).

Since styrene derivatives are employed heavily in the construction, packaging, automotive industries and use in the manufacture of consumer goods, ethylbenzene demand is directly related to the gross domestic product. Historically, ethylbenzene grew at a rate of 6.2 percent per year from 1982 through 1991; however, future growth is projected to be about 2.5 percent per year through 1996 (CMR 1992b; MCP 1993c).

I. ETHYLENE DICHLORIDE

Ethylene dichloride (also known as 1,2-dichloroethane) is one of the top 50 industrial chemicals in the US, ranking 15th and 14th for 1991 and 1992, respectively (C&EN 1993). Its 1992 estimated end-use pattern is as follows (MCP 1993d):

Derivative	Percent
Vinyl chloride monomer	94
Intermediate	5
Miscellaneous	1

Ethylene dichloride is used mainly for the production of vinyl chloride monomer (VCM). VCM is used almost exclusively to manufacture polyvinyl chloride (PVC), copolymers of VCM (e.g., VCM-vinyl acetate), and chlorinated PVC. As an intermediate, ethylene dichloride derivatives include ethylene diamines and chlorinated solvents such as perchloroethylene, trichloroethylene, and 1,1,1-trichloroethane. Miscellaneous applications include solvents for rubber, resins, fats, oils, and waxes (MCP 1993d; USEPA 1994d).

Ethylene dichloride demand is nearly dependent on PVC demand due environmental pressures on the chlorinated solvents sector. While historical growth rates averaged 4.1 percent per year (1982 -1991), future growth through 1996 will average 3.5 percent per year (CMR 1992c; MCP 1993d).

J. ETHYLENE GLYCOL

Ethylene glycol is one of the top 50 industrial chemicals in the US, ranking 30th in both 1991 and 1992 (C&EN 1993). The 1992 estimate of ethylene glycol's end-use pattern is as follows (MCP 1993e):

Derivative	Percent
Polyester:	
Fibers	30
Plastics (films/bottles)	22
Antifreeze	38
Miscellaneous	10

The major end-use for ethylene glycol is in the manufacture of polyethylene terephthalate (PET) resin, which is used for fibers, films, bottles, and other molded plastics, laminates, and castings. Ethylene glycol is used as an antifreeze in heating and cooling systems, a de-icing agent on bridges and airport runways, and a solvent in the paints and plastics industry. It is used in hydraulic brake fluids, printer's inks, and inks for stamp pads and ball point pens (MCP 1993e; USEPA 1993f).

Historically, ethylene glycol grew at a rate of 2 percent per year from 1983 through 1992; however, future growth is projected to be about 2.6 percent per year through 1997 (CMR 1993c; MCP 1993e).

K. HYDROCHLORIC ACID

Hydrochloric acid is one of the top 50 industrial chemicals in the US, ranking 25th and 26th for 1991 and 1992, respectively (C&EN 1993). Its 1992 estimated end-use pattern is as follows (MCP 1993f):

Derivative	Percent
Chemical manufacturing	30
Steel pickling	25
Oil & gas well acidizing	20
Food processing	15
Miscellaneous	10

HCl has many uses which include the manufacture of pharmaceutical hydrochlorides, vinyl chloride from acetylene, alkyl chlorides from olefins, and arsenious chloride from arsenious oxide. HCl is also used in the dissolution of minerals, pickling and etching of metals, regeneration of ion-exchange resins for water treatment, neutralization of alkaline products or waste materials, acidification of brine in chlor-alkali electrolysis, production of tin and tantalum, as an analytical reagent deliming agent for hides, coagulation of latex, pH control, desulfurization agent for petroleum, hydrolyzing starch and proteins in the preparation of various food products, cleaning boilers, and heat-exchange equipment, pharmaceutic aid as acidifier, as a gastric acidifier in veterinary medicine, in the chlorination of rubber, as a gaseous flux for babbitting operations, and in isomerization, polymerization, and alkylation reactions (USEPA 1994e).

Other uses of HCl include phosphoric acid production, silica gel production, preparation of dyes and dye intermediates, reclamation of rubber, production of casein plastics, manufacture of paint pigments, and for etching airport runways in preparation for resurfacing with bonded concrete (USEPA 1994e).

Overall demand for hydrochloric acid is projected to grow annually by only 1 - 2 percent for the next five years (MCP 1993f).

L. HYDROGEN FLUORIDE

The estimate of hydrogen fluoride's (HF) end-use pattern is as follows (CMR 1991a):

Derivative	Percent
Fluorocarbons	58
Aluminum manufacture (captive HF)	15
Petroleum alkylation catalysis	4
Stainless steel pickling	4
Uranium chemical production	3
Aluminum manufacture (merchant HF)	3
Miscellaneous (glass etching, herbicides, rare metals, fluoride salts, and specialty fluorides)	13

Hydrogen fluoride is primarily used in the production of fluorocarbons (CFCs), which are being phased out. The hydrogen fluoride consumed by the aluminum industry (18% of production) is used to produce synthetic cryolite, which is used in the reduction of aluminum in electrolysis cells; this process gives off hydrogen fluoride which may be recycled (captive HF). Hydrogen fluoride is also used in the production of branched alkane motor fuels, aerosols, plastics, and refrigerants. In the field of atomic energy, it is used in the production of uranium tetrafluoride from uranium oxide, and it is used in certain types of rocket fuels. Hydrogen fluoride is also used in cleaning cast iron, copper, and brass; removing efflorescence from brick and stone, or sand particles from metallic castings; working over too heavily weighted silks, frosting and etching glass and enamel; polishing crystal glass; decomposing cellulose; enameling and galvanizing iron; and increasing porosity of ceramics. Hydrogen fluoride salts are used as insecticides, to arrest undesirable fermentation in brewing, and in analytical work to determine SiO_2 (USEPA 1993g).

Historically, hydrogen fluoride grew at a rate of minus 0.4 percent per year from 1981 through 1990; however, future growth is projected to range from 0 to 2 percent per year through 1995 (CMR 1991a).

M. MALEIC ANHYDRIDE

The 1992 estimate of maleic anhydride's end-use pattern is as follows (MCP 1992a):

Derivative	Percent
Unsaturated polyester resins	57
Fumaric & malic acid	10
Lube oil additives	10
Maleic co-polymers	8
Agricultural chemicals	5
Miscellaneous	10

Polyester and alkyd resins (where up to 10 mole percent of maleic anhydride may be substituted for phthalic anhydride in alkyd resins), in particular, are used to make fiberglass reinforced plastics in the construction and electrical industries, in pipeline and marine construction, and in textile finishing. Maleic co-polymers are utilized in coatings, varnishes, and thermoplastics (MCP 1992a; USEPA 1993h).

Fumaric acid is produced from maleic anhydride and it is used as a food acidulant and in the production of resin and rosin adducts for paper sizing. Fumaric acid is also used to manufacture malic acid, also a food acidulant. Many surface active agents, ranging from lubricant additives to wetting agents, depend on maleic anhydride (MCP 1992a).

Agricultural chemicals that are produced from maleic anhydride include the pesticides captan and malathion, and the growth inhibitor maleic acid hydrazide. Maleic anhydride is also added to drying oils to reduce the drying time and improve the coating qualities of lacquers. Other uses include sulfosuccinic acid esters and alkenyl succinic anhydrides production (USEPA 1993h).

While historical growth rates averaged 4.3 percent per year (1982 - 1991) for maleic anhydride, future growth through 1996 will average 3 percent per year (CMR 1992d; MCP 1992a).

N. METHYL ISOBUTYL KETONE

Methyl isobutyl ketone (MIBK) is used primarily as a solvent in protective coatings, with a relatively minor amount used in some specialty adhesive and ink formulations. The end-use pattern (1992 estimate) for MIBK was (MCP 1993g):

Derivative	Percent
Protective coatings	62
Intermediate	18
Process solvent	13
Miscellaneous	7

As an intermediate, MIBK is a precursor to various rubber antioxidants and several specialty surfactants. In its role as a process solvent, MIBK is used in the separation and purification certain metal ions, in the extraction and purification of antibiotics and other pharmaceuticals, in the manufacturing of insecticides and other pesticides, and in other minor solvent extraction applications. MIBK is also used a denaturant for ethyl alcohol and as a solvent in textile coatings and leather finishing (MCP 1993g).

MIBK, historically, grew at a rate of 4 to 6 percent per year from 1983 through 1992; however, future growth is projected to be minus 3 percent per year through 1997 (CMR 1993d).

O. METHYL METHACRYLATE

Methyl methacrylate (MMA), in 1993, had the following end-use pattern (CMR 1994b):

Derivative	Percent
Acrylic plastics and resins	
Cast and extruded	32
molding powders/resins	15
Surface coatings	24
Impact modifiers	13
Emulsion polymers	8
Mineral-based sheet	3
Higher methacrylates	2
Polyester modifiers	2
Miscellaneous	1

Acrylic sheeting, made by casting, molding, or extrusion of poly(MMA) or modified polymers, is the largest application for MMA. Methyl methacrylate polymers and copolymers are used in water-borne, solvent, and solventless coatings for a variety of both commercial and industrial applications. Solvent and emulsion polymers containing methacrylates are used in adhesives, sealants, leather coatings, paper coatings, inks, floor polishes, and textile finishes. Specialty polymers are used dentistry and leaded radiation shields (MCP 1992b).

Growth for MMA is tied to the overall health of the US economy. A prosperous domestic auto industry, coupled with strong demand for housing, should give MMA a 3 to 4 percent annual growth rate through 1998. During the period 1984 - 1993, MMA grew at an annual rate of 2 to 3 percent (CMR 1994b).

P. NAPHTHALENE

The principal application for naphthalene is the production of phthalic anhydride, which is used to make plasticizers, unsaturated polyester resins, and alkyd resins. The 1993 end-use pattern is estimated as follows (CMR 1993e; MCP 1993h):

Derivative	Percent
Phthalic anhydride	65
Surfactants and dispersants	13
Insecticides	11
Moth repellant	6
Synthetic tanning agents	3
Miscellaneous	2

Naphthalene is a raw material that is used to produce a number of commercially important chemicals. Phthalic anhydride, an intermediate for PVC plasticizers, resins, and insecticides, is made from naphthalene by catalytic vapor-phase oxidation. Naphthalene is a feedstock for the manufacture of 2-naphthol and naphthalene sulfonic acid, which are used as intermediates in the synthesis of azo dyes. Naphthalene and alkylnaphthalene sulfonates are used as surfactants. Naphthalene sulfonate-formaldehyde condensates find use as tanning agents and dispersants for concrete. It is hydrogenated to produce the solvents tetralin and decalin. Diisopropylnaphthalenes are used as solvents for carbonless copy paper.

Naphthalene is also used to make chemicals that are used as pesticides, plant growth regulators, polyester/polyamide polymers, lube-oil additives, dispersants, flue gas desulfurization, and wood preservatives. Naphthalene itself is used as a moth repellant (USEPA 1993k).

During the ten-year period from 1983 to 1992, naphthalene grew annually at a rate of <u>minus</u> 3 percent; however, it is forecast to grow annually through 1997 at a rate of 2 to 3 percent (CMR 1993e).

Q. <u>PHENOL</u>

Phenol is one of the top 50 industrial chemicals in the US, ranking 35th and 34th for 1991 and 1992, respectively (C&EN 1993). Phenol's largest use is as a synthetic intermediate. Its estimated end-use pattern is (CMR 1993f):

Derivative	Percent
Bisphenol A	35
Phenolic resins	34
Caprolactam	15
Aniline	5
Alkylphenols	5
Xylenols	5
Miscellaneous	1

Bisphenol A is used primarily to produce epoxy and polycarbonate resins; a smaller amount is used to make phenoxy, polysulfone, and polyester resins. The largest use for phenolic resins is for adhesives (plywood), followed by binders for insulation (fiberglass, mineral wool, etc.), impregnating and laminating agents (for plastic and wood laminates), and for molding compounds and foundry resins. Caprolactam is used to make nylon-6, molding resin, or film forms. Aniline has numerous uses, such as in rubber processing compounds, dyes, pesticides, etc. Alkylphenols are used to produce surface active agents, emulsifiers, antioxidants, and lube oil additives. Xylenols are used to manufacture polyphenylene oxide, an engineering plastic (MCP 1992c).

Numerous miscellaneous applications include use as a general disinfectant, an additive in germicidal paints and slimicides, a selective solvent for refining lubricating oils, and in numerous medicinal and over-the-counter health and beauty aids (USEPA 1994f).

Historically, phenol grew at a rate of 3 to 4 percent per year from 1983 through 1992; however, future growth is projected to remain stable through 1997 with an annual grow rate of 3 to 4 percent (CMR 1993f).

R. PHTHALIC ANHYDRIDE

Phthalic anhydride's estimated end-use pattern for 1992 is (MCP 1993i):

Derivative	Percent
Phthalate plasticizers	53
Unsaturated polyesters	22
Alkyd resins	18
Miscellaneous	7

Phthalate plasticizers are used mainly to compound flexible polyvinyl chloride. Fiberglass-reinforced, unsaturated polyester resins are employed in numerous molding applications. Alkyd resins are a major workhorse in protective coating formulations. Miscellaneous uses include dyes, pigments, and polyester polyols. Phthalic anhydride is also used as a curing agent for epoxy resins that have important coating and structural applications (MCP 1993i; USEPA 1993l).

Phthalic anhydride, historically, grew at a rate of 2.8 percent per year from 1982 through 1991; however, future growth is projected to be 2 percent per year through 1996 (CMR 1992e).

S. 1,2,4-TRICHLOROBENZENE

Trichlorobenzenes are used as a component in some pesticides, as a dye carrier, in dielectric fluids, in lubricants, as a heat-transfer medium, and as an organic intermediate and solvent used in chemical manufacturing; however, the market for these uses is small and declining. Of the trichlorobenzenes, only 1,2,4-trichlorobenzene and 1,2,3-trichlorobenzene are sold in larger than research quantities. Dye carriers are used in the textile industry to achieve complete dye penetration of polyester fibers. They loosen the interpolymer dyes and allow water insoluble dyes to penetrate into the fiber. Trichlorobenzenes are one of the most commonly used dye carriers. 1,2,4-Trichlorobenzene was one of the most frequently used solvents in a gallium-arsenide wafer fabrication facility employing about 70 workers (USEPA 1993n).

No published market trend or growth rate data have been identified for 1,2,4-trichlorobenzene.

T. 1,1,2-TRICHLOROETHANE

Primarily important only as a feedstock intermediate in the production of vinylidene chloride and to some extent in the synthesis of tetrachloroethanes, 1,1,2-trichloroethane as a solvent for chlorinated rubbers, electronic components, pharmaceuticals, and other substances which may require high solvency properties. However, 1,1,2-trichloroethane's relatively high toxicity does not permit its general use as a solvent (USEPA 1994g). No end-use pattern has been identified in the literature searched.

U. VINYLIDENE CHLORIDE

Vinylidene chloride is used to manufacture poly(vinylidene chloride) (PVDC) and its copolymers with vinyl chloride, acrylonitrile, and acrylates. These polymers possess outstanding resistance to chemical attack and are efficient gas barriers. They are used for food packaging films (e.g., Saran Wrap), in paints and coatings, and in coatings for controlled-released fertilizers. Approximately 60 to 80 percent of vinylidene chloride production is used to manufacture PVDC and its copolymers; the rest is converted into 1,1,1-trichloroethane (USEPA 1994h).

IV. TESTING COSTS / ECONOMIC ANALYSIS

A. TESTING COSTS

The estimated test costs for the 21 hazardous air pollutants are based on the tests recommended by the Environmental Protection Agency. These tests and their estimated laboratory costs and burden are presented in Table 24. The cost range reflects the variations in testing protocol and cost differences among laboratories. The specific testing requirements and laboratory costs for each chemical are shown in Table 25. Laboratory costs are estimated to range between 20.1 and 33.1 million dollars.

In addition to laboratory costs, expenses associated with the administration of the testing program are incurred by the companies subject to the test rule. These administrative costs are estimated to be 25 percent of the laboratory costs (i.e., 5.0 to 8.3 million dollars). The total cost of testing, therefore, is the sum of laboratory and administrative costs, or 25.2 to 41.4 million dollars. To permit consistency of comparison, the total test costs are annualized using a cost of capital of seven percent over a period of 15 years, which is believed to be representative of the chemical industry. Thus, the annualized test costs range from 2.8 to 4.5 million dollars. These specific cost elements are summarized as follows:

COST ELEMENT	MINIMUM ($)	MAXIMUM ($)
Total Laboratory Costs	$20,148,320	$33,113,030
Total Administrative Costs	$ 5,037,080	$ 8,278,258
Total Test Costs	$25,185,400	$41,391,288
Total Annualized Test Costs	$ 2,765,222	$ 4,544,541

The annualized test costs are then divided by the total supply of the chemical (i.e., domestic production plus imports) to derive the unit test costs. The unit test costs, in turn, are divided by the compound's sales price to determine its price impact. The minimum price impact is estimated by dividing the upper-bound sales price into the minimum unit test costs; whereas, the maximum price impact is estimated by dividing the upper-bound unit test costs by the minimum sales price. These cost elements are summarized in Table 26.

Table 24. USEPA Recommended Tests and Their Estimated Laboratory Costs ($) and Burden (hours)

Protocol Title (Number)	Species	Route of Administration	Date of Estimate	Lab Costs ($) Best Estimate	Minimum	Maximum	Lab Burden (hrs)
Neurotoxicity Screening Battery (na)							
ACUTE	Rats	Aerosol	02/01/95	81,550	61,730	87,980	916
	Rats	Inhalation	04/27/94	59,030	49,160	69,920	691
SUBCHRONIC	Rats	Aerosol	02/01/95	295,460	237,450	358,650	5,298
	Rats	Inhalation	04/21/94	182,790	147,990	218,750	1,768
Mouse Sensory Irritation Assay (40 CFR 795.280 (ASTM E 981-84))							
	Mice	Nose cone	12/08/94	8,840	6,830	10,990	109
Acute Inhalation Toxicity (with post-exposure testing) (40 CFR 795.xx)							
	Rats	Vapor	11/15/94	57,160	46,830	68,320	693
	Rats	Aerosol	11/15/94	57,580	47,180	68,820	701
Subchronic Inhalation Toxicity (40 CFR 798.2450)							
	Rats	Aerosol	02/01/95	177,930	134,510	223,680	2,401
	Rats	Inhalation	01/11/94	176,810	133,590	222,350	2,377
Immunotoxicity Screen (40 CFR 798.2450 modified)							
	Rats	Dietary	11/10/94	64,220	47,720	81,160	563
	Rats	Aerosol	11/14/94	157,710	117,850	199,480	2,186
	Rats	Vapor	11/14/94	157,290	117,500	198,980	2,178
Subchronic Dietary Toxicity (40 CFR 798.2650)							
	Rats	Dietary	08/31/93	88,100	67,400	109,760	846
Oncogenicity (40 CFR 798.3300)							
	Mice	Aerosol	01/31/95	1,018,960	750,840	1,300,460	14,363
	Mice	Inhalation	01/10/94	1,017,770	749,860	1,299,040	14,339
	Rats	Aerosol	01/31/95	1,059,860	786,510	1,346,550	14,734
	Rats	Inhalation	01/10/94	1,058,740	785,580	1,345,220	14,710

Table 24. USEPA Recommended Tests and Their Estimated Laboratory Costs ($) and Burden (hours) (continued)

Protocol Title (Number)	Species	Route of Administration	Date of Estimate	Lab Costs ($) Best Estimate	Minimum	Maximum	Lab Burden (hrs)
Oncogenicity (40 CFR 798.3300 modified)							
	Female Mice & Male Rats	Vapor	02/01/95	1,047,150	775,150	1,332,630	14,726
Salmonella typhimurium Reverse Mutation Assay (40 CFR 798.5265)							
	Salmonella typhimurium		08/17/94	5,360	3,970	6,810	44
Detection of Gene Mutations in Somatic Cells in Culture (40 CFR 798.5300)							
	CHO/HGPRT		08/16/94	15,190	12,070	18,570	144
	Mouse Lymphoma		08/16/94	15,190	12,070	18,570	144
In Vivo Mammalian Bone Marrow Cytogenetics Tests: Chromosomal Analysis (40 CFR 798.5385)							
	Mice	Inhalation	08/17/94	24,480	20,410	28,980	339
In Vivo Mammalian Bone Marrow Cytogenetics Tests: Micronucleus Assay (40 CFR 798.5395)							
	Mice	Inhalation	08/22/94	24,480	20,410	28,980	339
Developmental Toxicity (40 CFR 798.4900)							
	Mice	Dietary	01/10/94	61,070	49,260	73,900	993
	Rats	Dietary	01/10/94	63,710	51,560	76,870	1,010
Developmental Toxicity (OPPTS 870.3700)							
	Mice	Aerosol	01/22/95	84,670	66,410	104,270	1,385
	Mice	Inhalation	08/17/94	83,480	65,430	102,850	1,361
	Rats	Aerosol	01/21/95	83,030	65,170	102,140	1,315
	Rats	Inhalation	04/20/94	81,840	64,180	100,720	1,291
Reproductive Toxicity (OPPTS 870.3800)							
	Rats	Aerosol	01/22/95	545,230	419,860	717,250	7,624
	Rats	Inhalation	04/20/94	544,040	418,880	715,830	7,600

Table 25. USEPA Recommended Tests and Their Estimated Laboratory Costs for the 21 Hazardous Air Pollutants

HAP Compound	Neurotoxicity Battery ACUTE (na) (Rats/Inhalation) **\1**		Neurotoxicity Battery SUBCHRONIC (na) (Rats/Inhalation) **\1**		Mouse Sensory Irritation Assay (40 CFR 795.280) (Mice/Nose cone)		Acute Inhalation Toxicity (40 CFR 795.xx) (Rats/Vapor) **\2**		Subchronic Inhalation Toxicity (40 CFR 798.2450) (Rats/Inhalation) **\3**	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Biphenyl	61,730 a	87,980 a	237,450 a	358,650 a	6,830	10,990	47,180 a	68,820 a	134,510 a	223,680 a
Carbonyl Sulfide	49,160	69,920	147,990	218,750	6,830	10,990	46,830	68,320	133,590	222,350
Chlorine	0	0	0	0	0	0	46,830	68,320	0	0
Chlorobenzene	49,160	69,920	147,990	218,750	0	0	46,830	68,320	133,590	222,350
Chloroprene	49,160	69,920	147,990	218,750	6,830	10,990	46,830	68,320	0	0
Cresols (mixed)	49,160	69,920	0	0	6,830	10,990	46,830	68,320	133,590	222,350
Diethanolamine	61,730 a	87,980 a	237,450 a	358,650 a	0	0	47,180 a	68,820 a	134,510 a	223,680 a
Ethyl Benzene	49,160	69,920	147,990	218,750	6,830	10,990	46,830	68,320	0	0
Ethylene Dichloride	49,160	69,920	147,990	218,750	6,830	10,990	46,830	68,320	133,590	222,350
Ethylene Glycol	49,160	69,920	147,990	218,750	6,830	10,990	46,830	68,320	133,590	222,350
Hydrochloric Acid	0	0	0	0	0	0	46,830	68,320	0	0
Hydrogen Fluoride	49,160	69,920	147,990	218,750	6,830	10,990	46,830	68,320	133,590	222,350
Maleic Anhydride	49,160	69,920	147,990	218,750	6,830	10,990	46,830	68,320	0	0
Methyl Isobutyl Ketone	0	0	0	0	0	0	46,830	68,320	0	0
Methyl Methacrylate	49,160	69,920	147,990	218,750	6,830	10,990	46,830	68,320	0	0
Naphthalene	0	0	0	0	6,830	10,990	46,830	68,320	0	0
Phenol	0	0	0	0	0	0	46,830	68,320	0	0
Phthalic Anhydride	61,730 a	87,980 a	237,450 a	358,650 a	6,830	10,990	47,180 a	68,820 a	134,510 a	223,680 a
1,2,4-Trichlorobenzene	49,160	69,920	147,990	218,750	6,830	10,990	46,830	68,320	0	0
1,1,2-Trichloroethane	49,160	69,920	147,990	218,750	6,830	10,990	46,830	68,320	133,590	222,350
Vinylidene Chloride	49,160	69,920	147,990	218,750	6,830	10,990	46,830	68,320	0	0

Notes:

\1 **Neurotoxicity Battery** cost estimates reflect a vapor-phase inhalation route of administration except for those costs labeled with an '**a**' which require the route of administration to be inhalation via aerosol and those costs labeled with a '**d**' which require the route of administration to be dietary.

\2 **Acute Inhalation Toxicity** cost estimates labeled with an '**a**' require the route of administration to be inhalation via aerosol and the costs reflect this route; all remaining cost estimates require and reflect vapor-phase inhalation.

\3 **Subchronic Inhalation** cost estimates reflect a vapor-phase inhalation route of administration except for those costs labeled with an '**a**' which require the route of administration to be inhalation via aerosol. Those estimates labeled with a '**d**' require the route of administration to be dietary; for these compounds, the appropriate protocol is 40 CFR 798.2650 and the costs used reflect this protocol.

Table 25. USEPA Recommended Tests and Their Estimated Laboratory Costs for the 21 Hazardous Air Pollutants (continued)

HAP Compound	Immunotoxicity Screen (40 CFR 795.2450 mod) (Rats/Vapor) **\1**		Oncogenicity (40 CFR 798.3300) (Mice/Inhalation) **\2**		Oncogenicity (40 CFR 798.3300) (Rats/Inhalation) **\2**		Salmonella typhimurium Reverse Mutation Assay (40 CFR 798.5265) (na)		Gene Mutations in Somatic Cell Culture (40 CFR 798.5300) (na)	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Biphenyl	117,850 a	199,480 a	0	0	0	0	0	0	0	0
Carbonyl Sulfide	117,500	198,980	749,860	1,299,040	785,580	1,345,220	3,970	6,810	12,070	18,570
Chlorine	0	0	0	0	0	0	0	0	0	0
Chlorobenzene	117,500	198,980	0	0	0	0	0	0	0	0
Chloroprene	117,500	198,980	0	0	0	0	0	0	0	0
Cresols (mixed)	117,500	198,980	0	0	0	0	0	0	0	0
Diethanolamine	117,850 a	199,480 a	0	0	0	0	0	0	0	0
Ethyl Benzene	117,500	198,980	0	0	0	0	0	0	0	0
Ethylene Dichloride	117,500	198,980	0	0	0	0	0	0	0	0
Ethylene Glycol	117,500	198,980	0	0	0	0	0	0	0	0
Hydrochloric Acid	0	0	0	0	0	0	0	0	0	0
Hydrogen Fluoride	117,500	198,980	0	0	0	0	0	0	0	0
Maleic Anhydride	117,500	198,980	749,860	1,299,040	785,580	1,345,220	0	0	0	0
Methyl Isobutyl Ketone	117,500	198,980	0	0	0	0	0	0	0	0
Methyl Methacrylate	117,500	198,980	0	0	0	0	0	0	0	0
Naphthalene	117,500	198,980	0	0	0	0	0	0	0	0
Phenol	0	0	0	0	0	0	0	0	0	0
Phthalic Anhydride	117,850 a	199,480 a	750,840 a	1,300,460 a	786,510 a	1,346,550 a	0	0	0	0
1,2,4-Trichlorobenzene	117,500	198,980	0	0	0	0	0	0	0	0
1,1,2-Trichloroethane	117,500	198,980	0	0	775,150 m	1,332,630 m	0	0	0	0
Vinylidene Chloride	117,500	198,980	0	0	0	0	0	0	0	0

Notes:

\1 **Immunotoxicity Screen** cost estimates labeled with an '**a**' utilize a route of administration of inhalation via aerosol; this route is the preferred inhalation route of administration for these compounds; all other costs reflect vapor-phase inhalation only.

\2 **Oncogenicity** cost estimates reflect a vapor-phase inhalation route of administration except for those cost estimates labeled with an '**a**' which require the route of administration to be inhalation via aerosol. The cost estimate labeled with an '**m**' represents a modified protocol requiring male rats and female mice.

Table 25. USEPA Recommended Tests and Their Estimated Laboratory Costs for the 21 Hazardous Air Pollutants (continued)

HAP Compound	In Vivo Mammalian Bone Marrow Cytogenetics (40 CFR 798.5385/5395) (Mice/Inhalation)		Developmental Toxicity (OPPTS 870.3700) (Mice/Inhalation) \1		Developmental Toxicity (OPPTS 870.3700) (Rats/Inhalation) \1		Reproductive Toxicity (OPPTS 870.3800) (Rats/Inhalation) \2		Total Laboratory Costs ($)		Laboratory Burden Hours
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	
Biphenyl	0	0	66,410 a	104,270 a	0	0	419,860 a	717,250 a	1,091,820	1,771,120	20,620
Carbonyl Sulfide	24,480	28,980	65,430	102,850	64,180	100,720	418,880	715,830	2,626,350	4,407,330	47,644
Chlorine	0	0	0	0	0	0	0	0	46,830	68,320	693
Chlorobenzene	0	0	0	0	0	0	0	0	495,070	778,320	7,707
Chloroprene	0	0	0	0	0	0	418,880	715,830	787,190	1,282,790	13,039
Cresols (mixed)	0	0	0	0	0	0	0	0	353,910	570,560	6,048
Diethanolamine	0	0	66,410 a	104,270 a	65,170 a	102,140 a	419,860 a	717,250 a	1,150,160	1,862,270	21,826
Ethyl Benzene	0	0	65,430	102,850	0	0	418,880	715,830	852,620	1,385,640	14,400
Ethylene Dichloride	0	0	0	0	64,180	100,720	418,880	715,830	984,960	1,605,860	16,707
Ethylene Glycol	0	0	0	0	0	0	0	0	501,900	789,310	7,816
Hydrochloric Acid	0	0	0	0	0	0	0	0	46,830	68,320	693
Hydrogen Fluoride	0	0	65,430	102,850	64,180	100,720	418,880	715,830	1,050,390	1,708,710	18,068
Maleic Anhydride	0	0	65,430	102,850	0	0	0	0	1,969,180	3,314,070	35,849
Methyl Isobutyl Ketone	0	0	0	0	0	0	418,880	715,830	583,210	983,130	10,471
Methyl Methacrylate	0	0	65,430	102,850	0	0	418,880	715,830	852,620	1,385,640	14,400
Naphthalene	0	0	0	0	0	0	418,880	715,830	590,040	994,120	10,580
Phenol	0	0	0	0	0	0	0	0	46,830	68,320	693
Phthalic Anhydride	0	0	66,410 a	104,270 a	65,170 a	102,140 a	419,860 a	717,250 a	2,694,340	4,520,270	51,032
1,2,4-Trichlorobenzene	0	0	65,430	102,850	64,180	100,720	0	0	497,920	770,530	8,091
1,1,2-Trichloroethane	24,480	28,980	65,430	102,850	64,180	100,720	418,880	715,830	1,850,020	3,070,320	33,133
Vinylidene Chloride	0	0	0	0	0	0	0	0	368,310	566,960	5,439
GRAND TOTALS \3									20,148,320	33,113,030	357,045
AVERAGE PER COMPOUND \3									876,014	1,439,697	15,524

Notes:

\1 **Developmental Toxicity** cost estimates reflect a vapor-phase inhalation route of administration except for those costs labeled with an '**a**' which require the route of administration to be inhalation via aerosol. Those estimates labeled with a '**d**' require the route of administration to be dietary; for these compounds, the appropriate protocol is 40 CFR 798.4900 and the costs used reflect this protocol.

\2 **Reproductive Toxicity** cost estimates reflect a vapor-phase inhalation route of administration except for those costs labeled with an '**a**' which require the route of administration to be inhalation via aerosol.

\3 The **GRAND TOTALS** for total laboratory costs and lab burden hours presented reflect the sum of all compounds costs and hours plus the costs and hours for mixed Cresols are multiplied by a factor of three to account for identical testing requirements on each of the three cresol isomers (i.e., para, meta, and ortho). The **AVERAGE**s, therefore, are based on 23 compounds (21 compounds as presented plus two additional cresol isomers).

Table 26. Summary of Annualized and Unit Test Costs with Associated Price Impacts for the 21 Hazardous Air Pollutants

HAP Compound	Total Laboratory Cost ($)		Total Admin. Cost ($)		Total Test Costs ($)		Annualized Test Costs ($)		Total Supply (000 lbs) (production + imports)\1		Unit Test Costs ($/lb)		Sales Price ($/lb)		Price Impact (%)	
	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Biphenyl	1,091,820	1,771,120	272,955	442,780	1,364,775	2,213,900	149,845	243,074	59,247	59,247 c	0.002529	0.004103	0.64	0.74	0.3418%	0.6411%
Carbonyl Sulfide	***2,626,350***	***4,407,330***	***656,588***	***1,101,833***	***3,282,938***	***5,509,163***	***360,449***	***604,876***	***0***	***0***	***NA***	***NA***	***0.00***	***0.00***	***NA***	***NA***
Chlorine	46,830	68,320	11,708	17,080	58,538	85,400	6,427	9,376	24,550,689	24,550,689 c	0.000000	0.000000	0.11	0.13	0.0002%	0.0003%
Chlorobenzene	495,070	778,320	123,768	194,580	618,838	972,900	67,945	106,819	198,865	198,865 c	0.000342	0.000537	0.55	0.55	0.0621%	0.0977%
Chloroprene	787,190	1,282,790	196,798	320,698	983,988	1,603,488	108,037	176,054	154,350	154,350 c	0.000700	0.001141	1.51	1.81	0.0387%	0.0755%
Cresols (mixed) **\2**	1,061,730	1,711,680	265,433	427,920	1,327,163	2,139,600	145,715	234,917	90,619	90,619 c	0.001608	0.002592	0.66	1.37	0.1174%	0.3928%
Diethanolamine	1,150,160	1,862,270	287,540	465,568	1,437,700	2,327,838	157,852	255,584	216,911	216,911 c	0.000728	0.001178	0.52	0.52	0.1399%	0.2266%
Ethyl Benzene	852,620	1,385,640	213,155	346,410	1,065,775	1,732,050	117,016	190,170	9,413,888	9,413,888 c	0.000012	0.000020	0.16	0.16	0.0078%	0.0126%
Ethylene Dichloride	984,960	1,605,860	246,240	401,465	1,231,200	2,007,325	135,179	220,393	18,226,039	18,226,039 c	0.000007	0.000012	0.17	0.17	0.0044%	0.0071%
Ethylene Glycol	501,900	789,310	125,475	197,328	627,375	986,638	68,882	108,327	5,578,217	5,578,217 c	0.000012	0.000019	0.20	0.24	0.0051%	0.0097%
Hydrochloric Acid	46,830	68,320	11,708	17,080	58,538	85,400	6,427	9,376	7,133,488	7,133,488 c	0.000001	0.000001	0.03	0.06	0.0016%	0.0040%
Hydrogen Fluoride	1,050,390	1,708,710	262,598	427,178	1,312,988	2,135,888	144,159	234,509	479,974	479,974 c	0.000300	0.000489	0.52	0.52	0.0578%	0.0940%
Maleic Anhydride	1,969,180	3,314,070	492,295	828,518	2,461,475	4,142,588	270,257	454,834	374,583	374,583 c	0.000721	0.001214	0.48	0.51	0.1415%	0.2530%
Methyl Isobutyl Ketone	583,210	983,130	145,803	245,783	729,013	1,228,913	80,042	134,928	164,862	164,862 c	0.000486	0.000818	0.51	0.53	0.0916%	0.1605%
Methyl Methacrylate	852,620	1,385,640	213,155	346,410	1,065,775	1,732,050	117,016	190,170	1,175,308	1,175,308 c	0.000100	0.000162	0.71	0.71	0.0140%	0.0228%
Naphthalene	590,040	994,120	147,510	248,530	737,550	1,242,650	80,979	136,436	289,728	289,728 b	0.000280	0.000471	0.29	0.40	0.0699%	0.1624%
Phenol	46,830	68,320	11,708	17,080	58,538	85,400	6,427	9,376	3,447,058	3,447,058 c	0.000002	0.000003	0.28	0.33	0.0006%	0.0010%
Phthalic Anhydride	2,694,340	4,520,270	673,585	1,130,068	3,367,925	5,650,338	369,780	620,377	917,010	917,010 c	0.000403	0.000677	0.33	0.45	0.0896%	0.2050%
1,2,4-Trichlorobenzene	***497,920***	***770,530***	***124,480***	***192,633***	***622,400***	***963,163***	***68,336***	***105,750***	***CBI***	***CBI a***	***CBI***	***CBI***	***1.25***	***1.25***	***CBI***	***CBI***
1,1,2-Trichloroethane	1,850,020	3,070,320	462,505	767,580	2,312,525	3,837,900	253,903	421,381	242,550	242,550 b	0.001047	0.001737	0.42	0.42	0.2492%	0.4136%
Vinylidene Chloride	368,310	566,960	92,078	141,740	460,388	708,700	50,548	77,811	179,190	179,190 b	0.000282	0.000434	0.37	0.37	0.0762%	0.1174%
GRAND TOTALS	20,148,320	33,113,030	5,037,080	8,278,258	25,185,400	41,391,288	2,765,222	4,544,541								

Notes:
\1 Total supply data is for different years as indicated by the following key codes:
a - supply data is for 1990

b - supply data is for 1992.

c - supply data is for 1993.

\2 The total laboratory costs presented in Table 25 for mixed Cresols is multiplied by a factor of three in Table 26 to account for identical testing requirements on each of the three cresol isomers (i.e., para, meta, and ortho).

B. ECONOMIC ANALYSIS

A preliminary determination of the potential for significant adverse impact can usually be made on the basis of the anticipated unit test costs for each chemical's manufacturers.

In this evaluation, if the unit costs of testing a chemical are less than one percent of the sales price of the chemical, then the potential for adverse economic impact due to the proposed test rule is low. Unit test costs greater than one percent of the chemical's sales price may indicate a greater potential for adverse economic impact. Table 27 presents for each HAP compound the supply volume and sale price necessary for a one percent of price impact level.

Based on currently available data (as shown in Table 26), it is assumed that only two of the 21 compounds (i.e., carbonyl sulfide and 1,2,4-trichlorobenzene) may exhibit a potential for adverse economic impact (since supply data either does not exist or is not publicly available) and will be discussed below.

1. Carbonyl Sulfide

Carbonyl sulfide is not produced in large quantities for commercial applications in the United States. It is, however, the most abundant sulfur-bearing compound in the atmosphere, although it is exceeded by hydrogen sulfide and sulfur dioxide in some industrial urban areas. Carbonyl sulfide is believed to originate from microbes, volcanoes, the burning of vegetation, and industrial processes. In industrial processes, carbonyl sulfide occurs as a by-product in the manufacture of carbon disulfide, in many manufactured fuel gases and refinery gases, and in combustion products of sulfur-containing fuels. It also tends to be concentrated in the propane fraction in gas fractionation which requires an amine sweetening process for its removal (Kirk-Othmer 1983).

Since no U.S. full-scale commercial production is known to exist, no production data of any kind (i.e., CBI or non-CBI) is available. No trade statistics are available. Furthermore, no sales price data is available for bulk quantities. Therefore, since no actual supply volume or sales price data is obtainable, an estimate of these respective values required to support testing at the one percent of price impact level is difficult to derive.

Table 27. Supply Volumes and Sale Prices Necessary to Support a One Percent Impact Level for Each HAP Compound

Price Impact @ 1.00% HAP Compound	Supply Vol (000 lbs)\1 Minimum	Supply Vol (000 lbs)\1 Maximum	Sales Price ($/lb) \2 Minimum	Sales Price ($/lb) \2 Maximum
Biphenyl	20,249	37,980	0.2529	0.4103
Carbonyl Sulfide	***NA***	***NA***	***NA***	***NA***
Chlorine	5,041	8,335	0.0000	0.0000
Chlorobenzene	12,354	19,422	0.0342	0.0537
Chloroprene	5,969	11,659	0.0700	0.1141
Cresols (mixed)	10,636	35,593	0.1608	0.2592
Diethanolamine	30,356	49,151	0.0728	0.1178
Ethyl Benzene	73,135	118,856	0.0012	0.0020
Ethylene Dichloride	79,517	129,643	0.0007	0.0012
Ethylene Glycol	28,701	54,164	0.0012	0.0019
Hydrochloric Acid	11,178	28,851	0.0001	0.0001
Hydrogen Fluoride	27,723	45,098	0.0300	0.0489
Maleic Anhydride	52,992	94,757	0.0721	0.1214
Methyl Isobutyl Ketone	15,102	26,456	0.0486	0.0818
Methyl Methacrylate	16,481	26,784	0.0100	0.0162
Naphthalene	20,245	47,047	0.0280	0.0471
Phenol	1,948	3,349	0.0002	0.0003
Phthalic Anhydride	82,173	187,993	0.0403	0.0677
1,2,4-Trichlorobenzene	***5,467***	***8,460***	***CBI***	***CBI***
1,1,2-Trichloroethane	60,453	100,329	0.1047	0.1737
Vinylidene Chloride	13,662	21,030	0.0282	0.0434

Notes:

\1 Sales price is fixed as per data in Table 26.

\2 Supply volume is fixed as per data in Table 26.

Based upon the current recommended testing scheme, Table 28 presents the sales price required to support testing at the one percent of sales price impact level for various hypothetical supply volumes of carbonyl sulfide since definitive supply data is unavailable.

With the currently available data, no conclusion is possible regarding the likelihood or degree of adverse economic impact of testing on the producers of carbonyl sulfide.

2. <u>1,2,4-Trichlorobenzene</u>

Trichlorobenzenes are used as a component in some pesticides, as a dye carrier, in dielectric fluids, in lubricants,

Table 28. Sales Price Required to Support Testing at the One Percent Impact Level for Various Hypothetical Supply Volumes

Hypothetical Supply Volume (lbs)	Sales Price ($/lb)			
	Carbonyl Sulfide		1,2,4-Trichlorobenzene	
	Minimum	Maximum	Minimum	Maximum
500,000	72.0898	120.9753	13.6672	21.1500
750,000	48.0599	80.6502	9.1115	14.1000
1,000,000	36.0449	60.4876	6.8336	10.5750
2,000,000	18.0224	30.2438	3.4168	5.2875
3,000,000	12.0150	20.1625	2.2779	3.5250
4,000,000	9.0112	15.1219	1.7084	2.6438
5,000,000	7.2090	12.0975	1.3667	2.1150
7,500,000	4.8060	8.0650	0.9111	1.4100
10,000,000	3.6045	6.0488	0.6834	1.0575
12,500,000	2.8836	4.8390	0.5467	0.8460
15,000,000	2.4030	4.0325	0.4556	0.7050
17,500,000	2.0597	3.4564	0.3905	0.6043
20,000,000	1.8022	3.0244	0.3417	0.5288
22,500,000	1.6020	2.6883	0.3037	0.4700
25,000,000	1.4418	2.4195	0.2733	0.4230
30,000,000	1.2015	2.0163	0.2278	0.3525
50,000,000	0.7209	1.2098	0.1367	0.2115
75,000,000	0.4806	0.8065	0.0911	0.1410
100,000,000	0.3604	0.6049	0.0683	0.1058
125,000,000	0.2884	0.4839	0.0547	0.0846
150,000,000	0.2403	0.4033	0.0456	0.0705
200,000,000	0.1802	0.3024	0.0342	0.0529

as a heat-transfer medium, and as an organic intermediate and solvent used in chemical manufacturing; however, the market for these uses is small and declining. Of the trichlorobenzenes, only 1,2,4-trichlorobenzene and 1,2,3-trichlorobenzene are sold in larger than research quantities (USEPA 1993n).

1,2,4-Trichlorobenzene has no non-CBI production information; however, CBI supply data does exist and, for 1990, production plus imports totalled ######### pounds (CBI) (USEPA 1995). 1,2,4-Trichlorobenzene has list price of $1.25 per pound (CMR 1994a).

Assuming the sales price remains constant, a supply volume of 5.5 - 8.4 million pounds of 1,2,4-trichlorobenzene would be required to support testing at the one percent of price impact level. On the other hand, assuming the supply volume remains constant, a sales price of #### - #### per pound (CBI) would be required to support 1,2,4-trichlorobenzene testing at the one percent of price impact level.

Based upon the current recommended testing scheme, Table 28 presents the sales price required to support testing at the one percent of sales price impact level for various hypothetical supply volumes (since only CBI supply data is available) of 1,2,4-trichlorobenzene.

With the currently available public data, no conclusion is possible regarding the likelihood or degree of adverse economic impact of testing on the manufacturers of 1,2,4-trichlorobenzene. However, utilizing CBI domestic supply data the impact of testing on 1,2,4-trichlorobenzene manufacturers is expected to be ######### (CBI) since the impact is estimated to be #### to #### percent of sales price (CBI).

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A. <u>BIPHENYL</u>
B. <u>CARBONYL SULFIDE</u>
C. <u>CHLORINE</u>
D. <u>CHLOROBENZENE</u>
E. <u>CHLOROPRENE</u>
F. <u>CRESOLS (mixed)</u>
G. <u>CUMENE</u>
H. <u>DIBUTYL PHTHALATE</u>
I. <u>DIETHANOLAMINE</u>
J. <u>ETHYL BENZENE</u>
K. <u>ETHYL CHLORIDE</u>
L. <u>ETHYLENE DICHLORIDE</u>
M. <u>ETHYLENE GLYCOL</u>
N. <u>HYDROCHLORIC ACID</u>
O. <u>HYDROGEN FLUORIDE</u>
P. <u>MALEIC ANHYDRIDE</u>
Q. <u>METHYL ISOBUTYL KETONE</u>
R. <u>METHYL METHACRYLATE</u>
S. <u>NAPHTHALENE</u>
T. <u>PHENOL</u>
U. <u>PHTHALIC ANHYDRIDE</u>
V. <u>1,2,4-TRICHLOROBENZENE</u>
W. <u>1,1,2-TRICHLOROETHANE</u>
X. <u>VINYL ACETATE</u>
Y. <u>VINYLIDENE CHLORIDE</u>

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